THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL

VOL. 49. Thursday, August 3, 1933. No. 885.

PUBLISHED WEEKLY.

Subscription Terms: 15s. per annum.
Foreign and Colonial: 17s. 6d. per annum.
All Subscriptions are payable in advance.

All Communications to be addressed to the Editor, the Advertisement Manager, or the Publisher of

THE FOUNDRY TRADE JOURNAL,
49, WELLINGTON STREET, LONDON, W.C.2.

Telegraphic Address: "Zacatecas, Rand, London."
Telephone: Temple Bar 3951 (5 lines).

Contents.

	PAGE
Forthcoming Event	59
Plastics—Their Future	59
The Prague Congress	59
Correspondence	60
Catalogue Received	60
Random Shots	60
Alloyed Grey Cast Iron	61
Mechanised Foundries	65
The Handling of Refractories	67
Iron in the Early Ages	67
Report on Routine Methods for Testing Green Sands	68
Institute of Metals	69
British Cast Iron Research Association	69
Student Number One	69
This Week's News in Brief	70
Trade Talk	70
Company Reports	70
Personal	70
Contracts Open	70
Obituary	70
Raw Material Markets	72
Scrap Movements	72

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN, THE NATIONAL IRONFOUNDING EMPLOYERS' FEDERATION, THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION.

Institute of British Foundrymen.

PRESIDENT: 1933-34.
C. E. Williams, "Coniston," Cefn-Coed Road, Penylan, Cardiff.

LIST OF SECRETARIES—
General Secretary: T. Makemson, Saint John Street Chambers, Deansgate, Manchester. London Office: 49, Wellington Street, London, W.C.2.
Birmingham, Coventry and West Midlands: L. W. Bolton, 21-23, St. Paul's Square, Birmingham.
Sheffield: T. R. Walker, 33, Ladysmith Avenue, Nether Edge, Sheffield.
Scottish: J. Bell, 60, St. Enoch Square, Glasgow.
Lancashire: J. E. Cooke, 1, Derbyshire Crescent, Stretford, Manchester.
London: H. W. Lockwood, Stewarts & Lloyds, Limited, Winchester House, Old Broad Street, London, E.C.2.
Newcastle-upon-Tyne: J. W. Eckford, 4, Mosley Street, Newcastle-upon-Tyne.
East Midlands: H. Bunting, 82, Otter Street, Derby.
West Riding of Yorkshire: S. W. Wise, 110, Pullan Avenue, Eccleshill, Bradford.
Wales and Monmouth: J. J. McClelland, 12, Clifton Place, Stow Hill, Newport, Mon.
Middlesbrough: F. A. Harper, Station Chambers, Middlesbrough

National Ironfounding Employers' Federation.

President: J. Smith, Smith & Company (South Shields), Limited, Nile Street, South Shields.
Secretary: J. A. Hassal, 106, India Buildings, Liverpool.

Foundry Trades' Equipment and Supplies Association.

President: R. H. Brackenbury, 13, Victoria Street, London, S.W.1.

Secretary: K. W. Bridges, Grand Buildings, Trafalgar Square, London, W.C.2.

Welsh Engineers' and Founders' Association.

President: W. E. Clements, Morfa Foundry, New Dock, Llanelly.
Secretary: E. J. Griffiths, 2, Royal Metal Exchange, Swansea.

BRITISH CAST IRON RESEARCH ASSOCIATION.

The Registered Office and Laboratories of the B.C.I.R.A. at:—
21-23, ST. PAUL'S SQUARE, BIRMINGHAM.
Telephone: Central 1886. *Telegrams: CIRA.*

The B.C.I.R.A. Scottish Laboratories are:—
Foundry Technical Institute, Meek's Road, Falkirk (*Telephone* 332).

Forthcoming Event.

SEPTEMBER 18-21.
Institute of Metals:—Silver Jubilee Autumn Meeting in Birmingham.

Plastics—Their Future.

We have borrowed the title of this leading article from a piece of publicity sent to us by the Society of Chemical Industry, and we would straight away congratulate this comparatively new industry on the efforts it is putting forward to make the population conscious of the properties of a large group of materials known as "Plastics." A quotation from the opening paragraph will show that the manufacturers have unbounded confidence in the future of their industry. This paragraph reads: "The Stone Age has passed, the Iron Age gone. The Plastic Age is coming. There is every indication that plastics will have a profound effect on construction and designs of the future. Within 25 years the plastic industry will be one of the most important industries in the country."

While we admire the excellence of these publicity efforts, we can honestly state that our personal acquaintance with this group of materials has been far from satisfactory, and as yet no real engineering service has been demanded from it. Our experience has been as follows:—*Telephone receivers*, too brittle; *sponge rack resting across the bath*, crazed, warped and fractured; *tooth-brush rack*, discoloured and warped to such an extent that the tooth-brush now needs forcing through the apertures; *flower bowl*, colour has faded badly; *teacups*, brittle, harsh to the touch and influences deleteriously the taste of hot and cold beverages; *door knobs*, satisfactory. Obviously, as an electrical insulator, plastics have a deservedly excellent reputation, but bearing in mind our experience of warping brittleness, we can find no real excuse for the utilisation of such material for fuse and switch boxes.

Yet some of the large electrical generating concerns are replacing grey-iron castings by plastic mouldings. If one admits, which we do not, that plastic mouldings have a better appearance than grey-iron castings, that is of but little consequence, as the particular type of switch box of which such large quantities have been ordered is destined to live a useful life under stairs and in kitchen pantries. It may have been the irony of fate, but when the representative of the foundry called to see why his firm had lost the order, the buyer proudly produced the plastic moulding and dropped it on the floor to prove its lack of brittleness. Unfortunately for the buyer, the box shattered! If the grey-iron foundries interested in furnishing this type of article would carry out a few tests as to strength (impact), and the influence of dampness and time on warping and growth, we believe this competition could be overcome. If appearance is a selling point, then resort can be made to vitreous enamelling.

The Prague Congress.

A very few weeks now have to elapse before the International Congress at Prague, and we would like to assist as much as possible those of our readers who contemplate going, but who have not yet arrived at a final decision. The Congress opens on September 9 at Prague, from whence the party proceeds to Moravska Ostrava, visits the Bata shoe factories at Zlin on the way to Brno, and then proceeds to Pilsen. The provisional programme so far issued unfortunately does not give full details of the visits, and we have as yet no final official information, but the following will probably indicate the nature of the visits to be paid.

Much of the iron ore mined in Czecho-Slovakia is obtained near Prague, where one company operates two blast-furnace plants: Konigshof, with four furnaces, and Kladno, with four furnaces. In Prague itself are some large engineering works, one of which, the C.K.D. works, has a foundry normally employing 1,500 men. Moravska Ostrava is perhaps the most highly industrialised area in Czecho-Slovakia, for here are the famous Vitcovice (Witkowitz) and Trinec blast-furnace plants; the former having seven furnaces and the latter four, with the only plant in the country producing metallurgical coke. Witkowitz normally employs thirty-five thousand people.

At Brno there are several engineering works and foundries, which were originally plants for the production of charcoal pig-iron. At Pilsen, where the tour ends, is the renowned Skoda works, a large steelworks normally employing about thirty-five thousand people, and, like Witkowitz, having every variety of foundry. Appropriately enough, after such a strenuous tour, the party will visit the famous brewery at Pilsen, together with one of the largest refractory works on the Continent. The country produces not only grey-iron and steel castings and non-ferrous alloys, including electron, but also black-heart and white-heart malleable.

It will be seen that every variety of foundry interest can be catered for, and with the direct patronage of the Government, a useful and interesting visit should be enjoyed by all those who are able to participate in it. The Congress officially concludes on September 16, but visits to places of interest can be arranged by those who will regard the period as part of a holiday.

C

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Cast Metal Vital in Welding.

To the Editor of The Foundry Trade Journal.

Sir,—In your editorial comments on the Paper presented by Mr. J. G. Pearce to the Institute of Welding Engineers, you made the very important point that founders and welders can learn much from each other. This is undoubtedly true and is often too little appreciated.

Much recent research on casting problems has been of very direct benefit to the welding industry. An excellent example is provided by the many investigations on gases in metals, which have shown the importance of using gas-free raw materials.

It should be pointed out, however, that there are fundamental differences between the "cast" metal of a weld and the metal of a sand or chill casting, and it is scarcely true to suggest that the properties of weld metal can never be better than those of a casting, if the latter is interpreted commercially.

Some of the factors which govern the properties of cast metal are melting conditions, cooling rate, cooling stresses and facility for gas liberation. To review these, even briefly, would be a long task, and I must be content with suggesting that it is only possible to compare weld metal closely with the metal of a casting when these factors are taken into account for each particular case under consideration.

Although it may be true (it is not always) that the vital spots in a welded structure are essentially castings, it must be remembered that they are unique castings and frequently possess properties at present unobtainable from metal which has been poured into a mould.—Yours, etc.,

H. W. H. Hignett.

The Aluminium Plant & Vessel Company, Limited,
Point Pleasant,
Wandsworth,
London, S.W.18.
July 29, 1933.

[We suggest that as many runs of weld metal are hammered, a certain amount of mechanical work is placed on the metal.—Editor.]

Me Fecit 1569.

To the Editor of The Foundry Trade Journal.

Sir,—Mr. Glynne Williams's letter of July 25 appears to leave little room for anyone to doubt that the bell, of which an illustration is furnished, is anything but the product of the craftsman named thereon and a genuine sixteenth-century antique. However, I, for one, have some slight misgiving on this matter. Table bells, very similar in design to the example in question and with spurious imitations of the inscriptions of old church bells cast thereon—one such bell is on my table at the moment—have been on sale for ages past, and fresh supplies, even to-day, are purchasable from the recognised dealers in pseudo antique cast-brass candlesticks, door-knockers and suchlike fancy goods. The very name and date cast on the skirt of the bell, as described by Mr. Glynne Williams, arouses suspicion that his bell is not what it purports to be.

No name amongst the names of the ancient church-bell founders is more honoured to-day than that of Hémony, and I submit that the name H-MONY in capitals—and not as printed in the Journal—is a travesty of the renowned name of a master craftsman.

I have sought for and found an illustration of a genuine old church bell bearing the honoured name of Hémony with, in addition, the legend: ME FEC: A 1663.

There were two brothers Hémony, François and Pierre, *d'origine française*, and both followed the craft of bell-founding in the Low Country in the seventeenth century. François died at Utrecht in 1667 and Pierre—described as "Le roi des fondeurs de cloches"—in 1680, at Amsterdam. From the foundries of the Hémonys, it has been estimated that carillons were produced to the value of 3,000,000 francs—a big sum in those days.

"A large majority of the bells of Holland are the manufacture of the Hémonys; in Belgium, most of the present bells of Mechlin and of Antwerp are by them; while outside the Netherlands, they supplied carillons to Stockholm, Hamburg, Mainz and Darmstadt."—("Carillons of Belgium and Holland," by William Gordon Rice: London. 1915. John Lane, The Bodley Head.)

With regard to dates, it is obvious from those given above that the Hémonys, François and Pierre, practised their craft in the seventeenth century. The Rev. Tyack,* however, writes: "Hémony, the Belgian bell-founder of the sixteenth century . . ." If there was such a craftsman in that century—although I have not been able to verify that this is so—then the date (1569) on Mr. Glynne Williams's bell can the better be understood.

In conclusion, it is interesting to note that the brothers Hémony were intensely religious, but this fact did not preclude them from casting cannon as well as church bells. Maybe they salved their consciences by stipulating that the cannon were to be used solely for defensive purposes.—Yours, etc.,

Wesley Lambert.

28, Canadian Avenue,
London, S.E.6.
July 29, 1933.

* "A Book about Bells," by Rev. Geo. S. Tyack, B.A. William Andrews and Company, London, 1898.

Catalogue Received.

Engineering Productions.—We have received from Messrs. Davy Bros., Limited, Park Iron Works, Sheffield, a 64-page well-illustrated brochure, which illustrates and shortly describes in three sections the rolling mill, hydraulic and other machinery which they manufacture. We have felt more than a little pride when travelling abroad to find that the largest individual piece of machinery installed in the armament factories had been supplied by Davy Bros. To-day, the demand for such heavy presses is much less, but the experience gained gives one confidence in the worth of smaller and quicker presses and hammers, which now find a ready market. The largest and smallest presses, together with many special-duty machines, are illustrated, but we think, in view of current manufacturing conditions, more space might have been devoted to the smaller variety. The same remark applies also to the rolling-mill section, where quite small plant is wanted for the non-ferrous industry. We congratulate the officer responsible for the lay-out of the brochure, and we are especially enthusiastic about page 10, which is a striking illustration of a blooming-mill lay-out. The jacketing has been carried out in green imitation leatherette, with the captions picked out in silver. We have tried to imagine what it would look like with gold lettering, and we imagine that an improvement would be registered. A further improvement would have been to round off the corners.

Permeability of Iron Ores and Refractories.—In the "Journal of the Japanese Ceramic Association" Y. Tadokoro describes experimental work on the permeability to gas flow of various iron ores and refractories at high temperatures, and determines the temperature coefficient of the specific permeability.

Random Shots.

This England of ours—it does not seem poetic to say "This Great Britain and Northern Ireland of ours," although we mean it—appears out of date among the countries of 1933. We are still nineteen-fourteenians in so far as we choose a live-and-let-live style of government. I have had a dream. I lived under the heel of a British Bolfazis *régime*. It was the result of a badly-mixed grill, and was something like this:—

* * *

Among recently-discovered violent counter-revolutionary criminals, espied secretively gathering together the disaffected daffodils of the Military Conservatorium, were some notorious acquaintances with whose capture I was not unnecessarily in disagreement. One good instance was Comrade Bob Watch. His counter-revolutionary tactics—or are they tic-tacs?—have been for a long time deliberately, maliciously, and with evil intent devoted to defeating our beloved Proletariat from being in time for the last train home. Comrade O. Zero Dial, the greatest of all counter-revolutionists, who has seen more revolutions than even the notorious Tachometerski, was found by one of our devoted Red Shirts sneakily taking a note of every turn of events in the People's Power Station. And lastly, gentlemen—or friends—could there be a more damning admission of counter-revolutionism than that recorded against ex-Comrade Phil Um, who is charged with winding up movie films backwards, with the obvious purpose of sabotaging them, at the end of the show at the Citizens' Arcadia Cinema? He dares tell us that it was merely to prepare them for the next demonstration to our Beloved People! We are nauseated with such counter, etc., excuses. Let us rid Utopia of these self-confessed capitalistic spies.

* * *

"Owed" to the Steam Roller.

See that Wicked technical man
Having a peep inside our works?
See that terrible commercial ham
Asking if perhaps an order lurks?
Such a counter-revolutionary move as theirs
The nerves of our Statesmen wears and tears.

See that brazen and dirty oil rag
Criminally falling off where it should be?
See that food in the Englishman's bag
Flaunted before us for our stomachs to see?
Such counter-revolutionary moves as these
Can scarcely be counted to put us at ease.

See those wonderful tractors we've made
That don't work as we thought they would do?
See how every plan that we've laid
Has been thwarted by the Bourgeois Hoodoo!
Such counter-revolutionary moves, I say,
Demand the penalty death, alone, can pay.

* * *

By-the-bye and lest we forget, I also dreamt I was in St. Leninsburg. It was before the advent of the Workers' and Peasants' salvation. My rank was that of a Russian Admiral, gay and bold. The gallant crews of our brave battleships were gathered around me. The massed bands were playing their praises. The newspapers had given full records of the hells through which the heroic sailor lads had just brought our ships. Nothing could quench the insatiable thirst of the people to glorify their national heroes. Yes, sir, we had a wonderful welcome home after the Battle of the Dogger Bank! Some of you forget the event? Ah, what a pity! It was during the Russo-Japanese War. With flagrant treachery the British counter-revolutionists joined the Japanese ditto, and their massed navies, disguised as simple fishing trawlers, met us under cover of the night near the fortress of the Dogger Bank. You *do* remember. Good!

Marksman.

Alloyed Grey Cast Iron.*

By Dr. Ing. Carl W. Pfannenschmidt.

(Foundry Metallurgist; Humboldt-Deutz Motor Co., Cologne-Deutz, Germany.)

[German Exchange Paper.]

(Presented on behalf of the Verein Deutscher Eisengiessereien, Giessereiverband.)

Introduction.

When endeavouring to make one's self acquainted in a short time with the present-day range covered by alloyed grey cast iron—and it is now a wide one—the first thing to be done is to single out the uses which are likely to be of real technical interest. On the basis of the practical results so far available, five or six alloy elements come up for consideration. The Humboldt-Deutz Works have made practical use of a number of these for several years past; various researches bearing upon the structure of the alloyed cast iron are entered into in the following tables and illustrations taken from other Papers and publications are added to the author's own data for comparison purposes, or to point out findings which rest upon insufficient grounds.

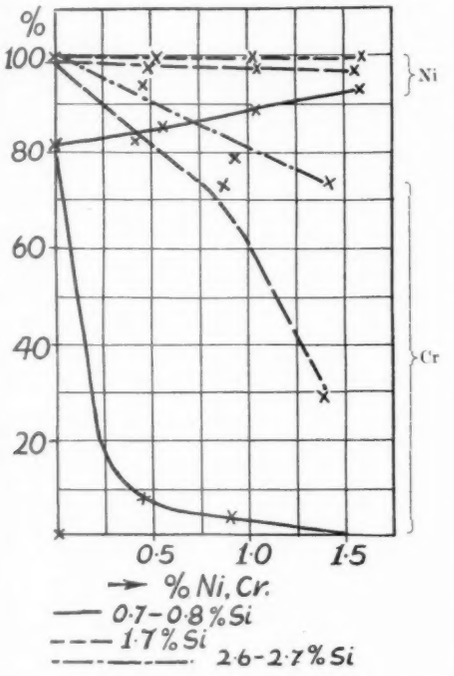


Fig. 1.—Influence of Cr and Ni on the Graphite Content in three Cast-Iron Mixes (21 Meltings in an Electric Furnace).

Although the technical side of the problem is placed foremost, the economic side may be said to be of almost greater importance. In this connection, however, we shall simply state that the user, and necessarily so, has always to be concerned with obtaining from an alloyed material for a special purpose all the advantages he possibly can; on the other hand, the question remains as to whether he is willing to go to the expense of the extra cost involved, and in most instances the extra cost is a high one. This being the case, the author has had in mind in the following simply the actual working costs and the losses experienced in the melting.

Roll's Classification.

Various contingencies have to be considered. Dr. Roll[1] has dealt with a classification in the periodical system, based upon the influence of the alloy elements upon the combined carbon. If in this connection one leaves out of account silicon, manganese, phosphorus and sulphur, which are always present, there remain, as carbide-promoting elements, boron, vanadium, chromium, arsenic, antimony, bismuth, and, further, molybdenum and tin as uncertain ones. From the technical standpoint vanadium, chromium and molybdenum have a claim to notice. In regard to the last element, attempts have been made to prove that it also is a carbide-promoting element in proportions ranging below 1 per cent.[2] Its influence is but slight for figures lower than 1 per cent.; it is indisputable for figures above that percentage.

General Influences.

Before going further into the question of the influence of these elements reference should be made to a highly important fact. In the case of alloyed grey cast iron, as, on the whole, in that of any class of grey cast iron, there being a pearlitic ground mass, the strength properties are decidedly influenced by the fineness of the graphite formation. The question as to whether an alloying pays in any given instance may be referred back to this structure. With reference to an improved heat-treatment and a higher capacity for withstanding high temperatures, so long as one can arrive at the desired results by using the original, unalloyed material, then the mixing of brands, treatment in the liquid state and transformation processes must of a necessity first be carried out. Too great an emphasis cannot be laid upon this point, for, otherwise, alloy additions made would not in most instances give the results expected; it has frequently occurred, following one failure, that quite wrong views have been entertained with respect to the value of alloy additions in general and to their economical advantages for particular instances. The researches dealt with below, made in the author's Works, are based almost entirely upon the classes of cast iron in question. It should be added at this point that in the series of alloyed materials other influences come into play besides those which involve mechanical strength alone.

Influence of Chromium.

In order to bear out the part played by chromium, it is practically necessary to consider it in connection with a simultaneous nickel addition. The reason for this lies mostly with the specific action of nickel and is dealt with later.

Chromium is one of the foremost carbide-forming and promoting elements. The constitution of the pure chromium carbide, or double carbide due to it, especially in combination with iron, has not so far been cleared up. A splitting-up of this carbide does not take place until liquefaction. Its resistance in this respect is such that a ferro-chrome having a high carbon content, containing therefore many carbides, is difficult of homogeneous solution. Hence, the great importance of the question as to the form in which the chromium has to be introduced into the cast iron.

Owing to very heavy losses and difficulties in melting, ferro-chrome is not suitable for the cupola. Researches with ferro-chrome additions made in the cupola, which a friend communicated to the author, show that this slow-melting metal behaves, as it were, like a trail in quite a number of tappings. Matters are somewhat less unfavourable when one deals with a comparatively low-alloyed cast iron or steel. Chrome-steel scrap, containing, say, 7 per cent. and even 15 per cent. of chromium, emanating from the manufacture of valves for internal-combustion engines, has been remelted repeatedly in quantities up to 20 per cent. of the charge in the case of small steel charges. The metallic losses in the operation has amounted to about 20 or 25 per cent. of the chromium content. A somewhat high limitation of this loss was made possible by using comparatively small pieces for the additions. Another means is to make the alloy additions in packets, in the form of the well-known "E. K. packets," similar to the silicon and manganese types. Ferro-chrome, highly disintegrated, has also been alloyed, with great regularity in action, to very hot iron, placing it in ladles having a capacity of about 4 cwts. Of late, additions in the ladle have been resorted to also in the form of packets containing, according to size, quantities of pure chromium weighing 1 and 2 lbs. The author has readily alloyed in this manner 2 cwts. of iron with up to 0.8 per cent. of chromium.

Chrome Heat-Resisting Castings.

The most important field for chrome-alloyed cast iron is that of heat-resisting castings. By increasing the chromium content, almost all stages of improvement can be attained, from an improvement in the growth phenomena peculiar to non-alloyed cast iron, to a practically complete high heat-resisting property. As an illustration, Fig. 1 shows, besides an appropriate nickel series, the influence of the increase in the chromium content on the graphite of three different highly-siliconised grey cast iron melts. These are electric-crucible melts of about 1 kg. in weight, allowed to cool down in the furnace after having been heated to approximately the same melting temperature. Researches made by Goerens and Stadeler[3] with irons of other composition can be referred to.

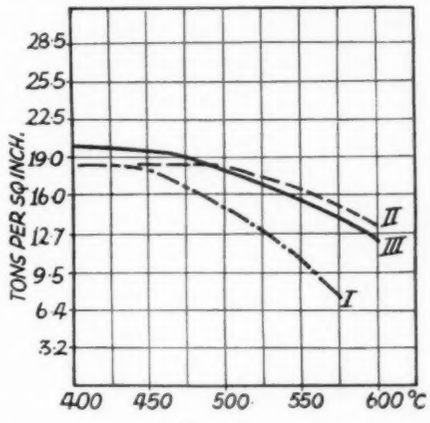


Fig. 2.

Curve I. Maintained at 500 hrs. at elevated temperatures and tested at those temperatures.

Curve II. Maintained at elevated temperatures for 500 hrs., cooled in the furnace and tested at room temperatures.

Curve III. Without prolonged heating, tested at the temperature indicated. Composition: T.C., 3.46; Gr, 2.59; Si, 1.36; Mn, 0.68; S, 0.08; P, 0.39, and Cr. 0.54 per cent. (From MacPherran & Krueger.)

The favourable influence of chromium for preventing, or at all events for greatly minimising growth, has already been largely dealt with.[4] The maintenance of its tensile-test values by chrome-alloyed cast iron at high temperatures has been recently referred to, with numerous examples by MacPherran and Krüger.[5] Fig. 2 gives tensile-strength curves at elevated temperatures, also the run of the strength values of specimens heated over a long period. With reference to the parallel variation in the combined carbon content, seven-day heating tests revealed

* A Paper presented at the Cardiff Conference of the Institute of British Foundrymen.

that from a temperature of 520 deg. C. all the cast-iron specimens dealt with, apart from those chrome-alloyed, showed a slowly-increasing graphite content. At 610 deg. C. conditions remained the same. Dilatometrical tests by Wentrup and Stenger[6] also showed that a splitting-up of the ground mass did not occur with

Fig. 3a.—Sample No. 455, Chromium Alloyed Cast Iron. × 250.

even only 0.22 per cent. of chromium present. The simultaneous improvement in the transverse-strength values has been pointed out by Jennings.[7] A cast iron containing 3.7 per cent. of carbon and 2.2 per cent. of silicon, and following additions made in steps, up to 0.8 per cent. of chromium, showed improvement in transverse-strength values up to 40 per cent. Many references in literature can be made in regard to the point, but mostly applicable to chrome-nickel alloyed cast iron.

Influence of Chrome on Machinability.

The question as to how high one can go with the chromium addition without entailing difficulties in machining rests with the silicon content. Taking the 30-mm. (1⅛ in.) green-sand cast bar for a comparison scale, then with 1.5 per cent. of silicon one can go up to 0.4 per cent. of chromium, and with 2.3 per cent. of silicon up to 0.7 per cent. of chromium, without fear of meeting trouble in machining.

An extensive work by Valenta[8] has covered almost the whole field of chrome-cast iron alloys. Houdremont and Wasmuth[9] have dealt with the chromium contents of 33 to 35 per cent. The displacement to the left of the phases of the complete Fe-Cr-C diagram, worked out originally by Oberhoffer and Daeves,[10] has been amplified by Valenta by including aluminium and silicon additions.

In all these alloys, which have nothing in common with grey cast iron apart from the high-carbon content, the Brinell hardness is the lower, the lower is the carbon content for a same percentage of chromium. Fig. 3, which applies to a series of personal researches, shows an alloy melted in an electric furnace and having the following analysis (hypoeutectic): C 1.85; Cr 15.3; Si 0.3; P 0.15, and S 0.018 per cent.

Owing to its plain hypoeutectic character, this is not absolutely heat-resisting. After several weeks of repeated heatings in an oxidising atmosphere and a heat up to somewhat over 1,000 deg. C., the test specimen was highly soaked; the structure reveals the effects. The sample could be drilled with a Widia-tipped tool, and it showed on an 8-mm. (⅜ in.) thick section a 300 Brinell hardness number. Specimens having a markedly higher chromium content have behaved satisfactorily for two months in a highly oxidising atmosphere in a furnace at the author's works. The heat-resisting limit gathered from the researches by Schüz[11] corresponds to that derived personally. The carbon content of the author's alloys was always maintained over 3 per cent.; all the specimens were melted in crucibles. Machining with a planing tool could not be carried out.

Such and similar alloys, and others containing also some nickel or other constituents are, however, somewhat of ancient date; they have been used in the past and will be used still further.

The unmachinable properties of these chromium alloys which are practically heat-resisting, together with the experience gained of late years in regard to the durability of high-silicon iron which, following upon researches by von Keil and Mitschke,[12] and by English scientists, has proved itself to be of a non-growth character and heat-resisting, would point to a combination of the two elements. Keep has also worked on these lines, and alloys have been made containing up to about 10 per cent. of silicon and 15 per cent. of chromium. The results of personal work in the same field are detailed further on.

Chrome Nickel Alloyed Iron.

Chromium alloyed with nickel has been used much more frequently than the above. The literature in this connection fills a large volume and only a portion has been quoted.[13]

Nickel is a decidedly graphite-forming element. It is mentioned at this point in that it is generally met together with chromium. When it is used alone, the percentage of other elements which are also graphite forming must be reduced. Since, in this instance, silicon is concerned in the first place, it has been found that for a 2 per cent. addition of nickel, silicon has to be reduced correspondingly by 1 per cent. (Recommendations by the German Nickel Information Bureau.) This is not necessary when any

Fig. 3b.—Sample No. 455, showing Eutectic Pearlite and Carbide Areas. × 500.

notable chromium content is present at the same time. In this case, the relation worked to is Ni:Cr = 3:1.

Nickel Cast Iron.

Nickel alloys itself first with the ferrite of the ground mass; the ferrite becomes notably harder even with quite small nickel percentages, as revealed by the Brinell tests. This increase in hardness is remarkable in that up to high additions of nickel (up to about 4 per cent.) it is not accompanied by any deterioration of the machining properties. The nickel primarily decomposes the free, *i.e.*, the hypereutectoid cementite (segregated cementite). By reason of this peculiarity, a lower Brinell hardness is found precisely at those parts of a casting which

Fig. 4.—Austenitic Cast Iron, containing 20 per cent. Ni. × 500 Oil Immersed.

would have a tendency to harden owing to the presence of thin flanges or walls. Equalisation of the structure is apparent throughout the whole casting. The author has noted this in large-toothed gear wheels amongst other castings. Such massive castings in which the teeth had to be milled deep showed perfect soundness, combined with a perfectly regular hardness.

The microscope reveals that by increasing nickel additions the, otherwise, mostly lamellar pearlite, first becomes granular and then changes to sorbitic. Then martensite follows rapidly (from about 7 per cent. of nickel), then the softer austenite.

In regard to the way in which the additions are made, the author added direct to hot, cupola metal both pure granular nickel and nickel-steel scrap. Further, when using turnings containing nickel and chromium exclusively, he frequently obtained a synthetic "silbereisen*" in the electric furnace. By following a special melting method the author could at will obtain a carbon content varying between 2.4 and 3.2 per cent.

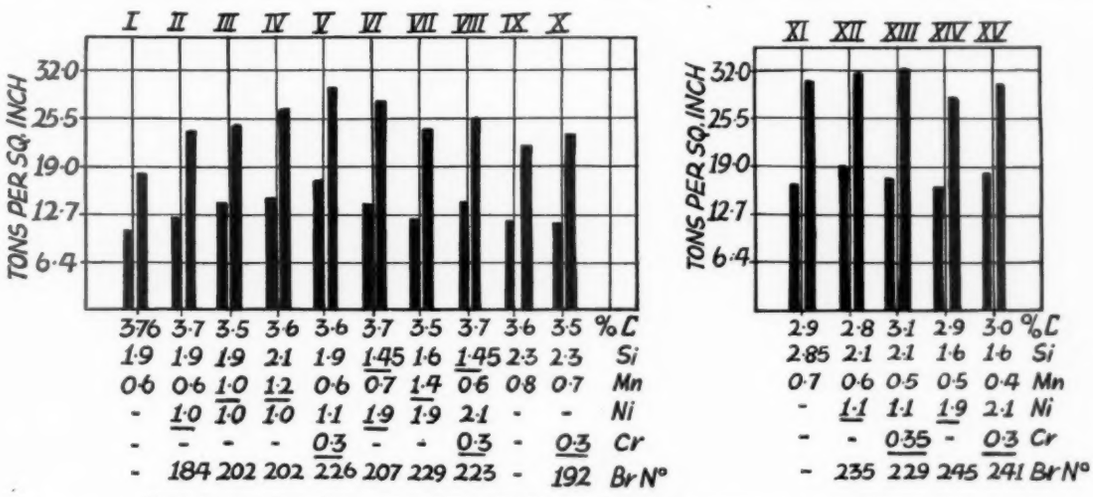
The martensite structure shows a Brinell hardness up to 350. The presence of graphite in this case makes for a lower Brinell hardness number than the 500 and more given by the martensite of steel. The austenite that follows shows a hardness of about 140. Fig. 4 illustrates an austenitic cast iron melted in a crucible and containing 20 per cent. of nickel.

Corrosion Resisting Properties.

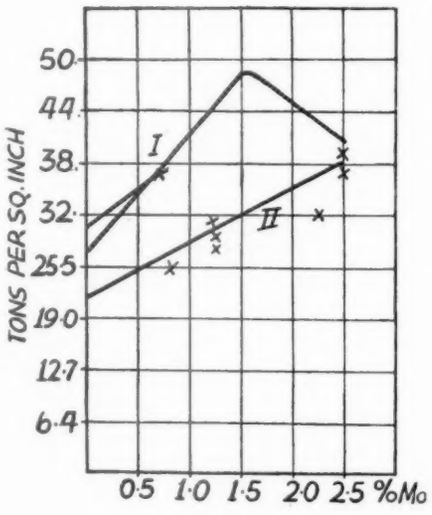
Whilst the martensitic series has but few uses, the austenitic is a more serviceable one, so far as the notably higher cost can be met. It has a remarkable resistance to corrosion. The melt illustrated, experimentally made by the author

* Silbereisen is made by mixing liquid pig-iron with liquid steel.—Ed.

at the request of a customer, showed very great resistance in the presence of hot alkalies. This improvement in the resistance to attack by alkalies is a striking property of nickel-alloyed cast iron. But quite apart from this expensive material good results are given by cheaper alloys. The author made experiments five years ago with 195 hrs. at a stretch in the solution, heated up to about 65 deg. C. In the case of a nickel content of 0.7 per cent. the losses were as 0.1 to 0.14 gramme per kg. The silicon content was low, a point which, according to the researches of Haase,[14] is of marked importance. It was believed for a long time that fine graphitic irons must show better resistance figures in this respect than the coarse graphitic ones, but Piwowarsky and Kötschke[13] pointed out that the form in which the graphite occurs is practically unimportant in regard to corrosion. Further researches by them have shown that nickel additions alone, up to 6 per cent., therefore, almost up to the martensitic structure, do not play any important part with reference to acid corrosion (see also Denecke)[15]; an advantage only ensues when simultaneous chromium additions are made. In alkalies, especially in saturated solutions of salts, nickel additions alone are distinctly advantageous (see also Denecke).[15] In the case of weak solutions, however, nickel alone confers no advantage, on the contrary, and simultaneously with chromium there is rather a disadvantage.



Figs. 5a and 5b.—Influence of Ni; Ni-Mn and Ni-Cr Additions on the Tensile and Transverse Strength.



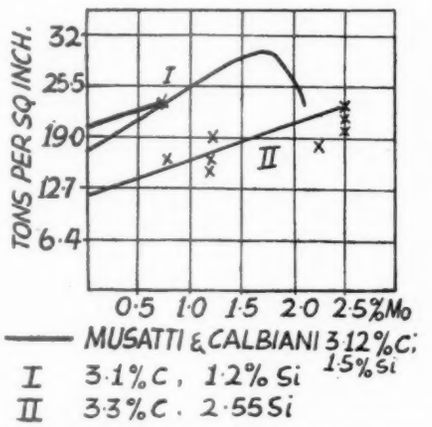


Fig. 6.—Influence of Mo on the Tensile Transverse Strength.

a view to improving the resistance of economiser pipes through which flowed water containing soda; two pieces for comparison purposes, both equal in size and in weight, were placed for

Ternary Alloys.

From the corrosion point of view, a ternary alloy gives the best results. According to the constitution diagram, a certain part of the nickel can be replaced by copper in these alloys. Virtually, concordant results of Denecke,[16] Rolfe,[16] Piwowarsky and Kötschke,[13] Pfannenschmidt[17] and Steinberg[18] show that an addition of Cu alone gave good results only up to 1.5 per cent. maximum. Ballay[19] and also Merica and Vanick[20] tried to replace Ni by Cu. Ballay dealt with copper-nickel alloys; Vanick and Merica added chromium. An addition of 5 to 6 per cent. of copper to a 12 per cent. nickel alloy, yields a pure austenitic alloy having a Brinell hardness number of about 120. A subsequent addition of about 1 per cent. of chromium increased this figure by about 20 points.

Alloys containing nickel alone show but a slight increase in resistance to attack by acids, but by also adding copper and a little chromium the resistance increases notably. The improved resistance to attack by acids is apparently to be ascribed to the copper, since this, contrarily to what obtains with nickel, increases the resistance to attack by acids, but not to attack by alkalis.[17, 18] The work by Vanick and Merica was taken by the International Nickel Company as a basis for a new class of cast iron which attains the resistance to corrosion of brass. They first used Monel metal obtained directly from ores and which contains nickel and copper in the ratio of 69:31. The liquid addition is made in quantities of about 20 per cent. to the grey iron. It has lately been given generally the name of "Niresist."[21] The behaviour of this ternary alloy and that of other cast-iron alloys in corrosion media is dealt with further on.

Nickel-Chrome Cast Iron.

The addition of nickel and chromium in small proportions simply to increase strength has taken gradually a back seat compared with the special purposes here referred to. In 1925, Piwowarsky recapitulated the world's knowledge in the matter as follows:—"It is possible to improve cast-iron mixes of average quality by special elements; he feared, however, that the measure of possible improvements strongly recedes proportionately as the question bears upon the further improvement in quality of a cast iron which, considered in itself, is already comparatively of high value." ("Stahl und Eisen," 1925, p. 296.)

In order to arrive at an opinion based upon actual personal experience, a complete series of experiments was made with charges melted in an oil-fired furnace without crucibles, of 350-kg. capacity. Fig. 5*a* and *b* gives the tensile-strength (left) and the transverse-strength figures side by side. The effect of a manganese addition can also be seen. The series 5*a* applies to an iron having a very high carbon content; 5*b* to a high-quality cast according to the German Standard Specification 26/91. In agreement with Piwowarsky, 5*a* shows that nickel makes for a slight increase in strength, which can be improved by increasing the manganese content. By adding chromium there follows a further notable improvement. Besides the test specimens, two Diesel-engine cylinder liners were cast from each series and were machined. The Brinell-hardness numbers were taken on the risers, therefore in a comparatively unfavourable location. The improvement in the strength values of the high-quality cast is not important.

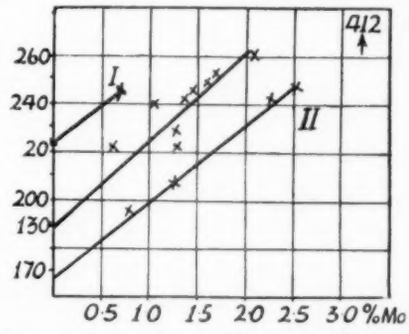
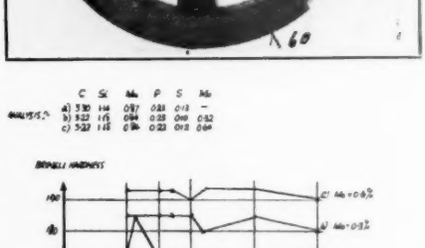


Fig. 7.—Influence of Mo on the Brinell Hardness.

Machining on the liners revealed quite clearly that the alloyed material surpassed the unalloyed in regularity.

As already alluded to, equalisation of the hardness is of great importance. In one instance in which hollow cylinders for piston rings, polish ground inside and out, had to be made, the



Figs. 8A and 8B.—Influence of Molybdenum on Brinell Hardness.

author obtained the best results with nickel additions of only 0.4 per cent. From further experience gained in the manufacture of four-cylinder blocks for petrol engines he found that with an addition of 0.5 per cent. of nickel thin flanges could be machined exceedingly well. In this connection it may be stated that the increased specific gravity of casts containing nickel referred to by Piwowarsky[19] in "Die Giesserei," 1928, page 1078, was confirmed.

Influence of Mo.

Referring again to the series of carbide-forming elements, a few remarks may be made as to the behaviour of molybdenum. Piwowarsky entertained great hopes in regard to molybdenum, also as to tungsten and vanadium ("Hochwertiger Grauguss," page 286). Researches by Campion[22] show that additions up to 1 per cent. of molybdenum give increased tensile strength, together with a slight decrease in hardness. According to Smalley,[23] with soft basis alloys (containing 2 per cent. of silicon), all the strength properties rose, starting from a molybdenum content of 0.5 per cent. Cylinder

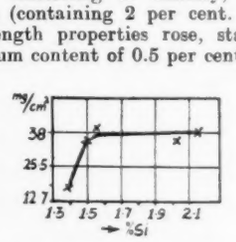
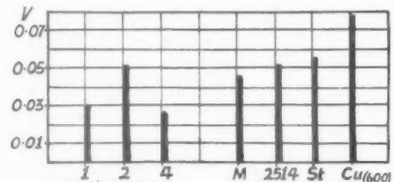
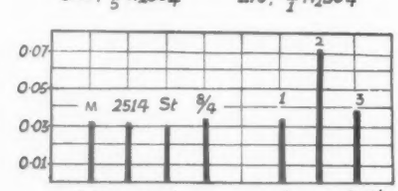


Fig. 9.—Influence of Silicon Content on Attack by 1 per cent. Acetic Acid.

castings containing 1.25 per cent. of silicon showed an important improvement in tensile strength, even from a 0.1 per cent. molybdenum content. Further work under this head is that of Smith and Aufderhaar,[24] Kent-Smith,[25] Musatti and Calbiani.[26] A large experimental series proceeding from the melting down in actual service conditions of 2.5 tons of metal was carried out by the author.[27] The raw material was a soft hematite, so that the hardening influence of molybdenum could reveal itself distinctly. The author has recently extended the tests to a cylinder cast iron, and has added experiments on the wear of the alloys made. Fig. 6 gives the curves of Musatti and Calbiani, also two of the author's, whilst Fig. 7 shows the Brinell hardness figures.

In the literature of nickel many experiments are described, which prove the beneficial influence of Ni on equal Brinell numbers in different wall sections. One of the author's friends made similar experiments on the influence of molybdenum. In Fig. 8A a fly-wheel is shown





SAMPLE No°	C	Si	Mn	S	P	Ni	Cr	Cu	Mo
1	2·6	6.21	0·4	0·05	0·2	—	—	—	—
2	3·3	2·3	0·8	0·06	0·27	0·20	—	—	—
4	3·0	3·4	-	0·03	0·47	—	0·4	1·0	—
3	3·4	2·1	0·55	0·12	0·7	—	—	—	—
2514	3·14	1·12	0·95	0·065	0·42	—	—	—	—
M	3·12	1·10	0·92	0·063	0·40	—	—	—	0·69
St	2·32	1·07	0·49	0·062	0·30	1·70	0·52	—	—
8/4	3·44	2·43	0·80	—	0·26	—	—	—	—
Cu (600)	2·90	4·51	0·90	0·050	0·48	—	1·53	0·90	—

*HEATED FOR 48 HOURS AT 600°

Fig. 10.—Influence of Composition on Acid Attack.

possessing very different wall thicknesses. Fig. 8B shows the Brinell hardness with different percentages of Mo. The beneficial influence of these small percentages of Mo is evident.

Wear Tests.

In regard to the resistance of castings to wear, the work by Vanick and Merica has shown that a metal containing 13 per cent. of nickel and 2 per cent. of chromium was five times as resistant as one unalloyed. The increase in cost of such an alloy is roughly 55 pf. per kg. (about 3d. per lb.). Researches by Musatti and Calbiani using an Amsler machine gave excellent wear values for an alloy containing 1.5 per cent. of molybdenum. The extra cost of this alloy is about 13 pf. per kg. (about 0.7d. per lb.). With this experimental material the author first made wear tests on a modified Lehmann machine, using cylinder-quality cast iron; these tests were then complemented by the following actual-service ones. A 12-h.p. Diesel engine was fitted with a cylinder liner of molybdenum-alloyed cast iron; it was kept running continuously under full load for 144 hrs. The cylinder was removed and the wear measured. This was found to be so low that it could be included practically within the tolerance limits. The same liner was then maintained in the same engine under full load for a further 156 hrs. After the whole 300 hrs., wear was measured twice at twenty-two places on a horizontal and a vertical axis, regularly over the length of the stroke of 160 mm. ($6\frac{1}{4}$ in.). The maximum wear was found to be 0.02 mm. (0.00078 in.), an

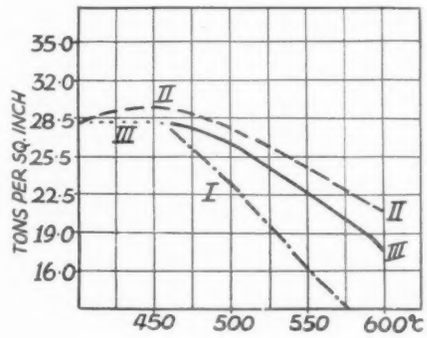


Fig. 11.

Curve I. Maintained for 500 hrs. at elevated temperatures and tested at the temperature indicated.

Curve II. Maintained at the temperature shown for 500 hrs., cooled in furnace and tested for tensile strength at room temperature.

Curve III. No prolonged heating but tested at the temperatures shown. Composition: T.C., 2.67; Gr. 1.58; Si, 2.39; Mn, 0.67; S, 0.09; P, 0.07; Ni, 0.76 and 0.45 per cent. (From MacPherran & Krueger.)

exceedingly low figure. Other measurements made on unalloyed castings and for approximately the same running time gave wear values about 1.5 times greater. From these tests, which are still in progress, it may be stated that a noted improvement is obtainable with even 0.3 per cent. of molybdenum.

BIBLIOGRAPHY.

1 Dr. Roll, Die Giess., 1929, p. 933.
2 Küster und Pfannenschmidt, Die Giess., 1931, pp. 54–58.
3 Goerens und Stadeler, "Metallurgie," 1907, p. 28.
4 Piwowarsky and Freitag, Die Giess., 1928, pp. 1193–1200 Table III: Bauer and Sipp, Die Giess., 1930, p. 989; Roll, Die Giess., 1930, p. 996; Bardenheuer, "Stahleisen," 1930, p. 71.
5 MacPherran and Krueger, A.F.A., 1931, pp. 826–864.
6 Wentrup and Stenger, Die Giess., 1931, pp. 24–28.
7 Jennings, A.F.A., 1931, pp. 801–808.
8 Valenta, "Carnegie Scholarship Memoirs," vol. xix.
9 Houdremont and Wasmuth, Die Giess., 32, p. 322.
10 Oberhoffer and Daeves "Stahleisen," 1920, vol. ii.
11 Schüz, Mittlgen. Gutehoffnungshütte, I (1930–31), pp. 34–40.
12 v. Keil and Mitschke, Die Giess., 1931, p. 200; Bull. B.C.I.R.A 32, Report No. 69.
13 Piwowarsky and Bauer, Stahl u. Eisen, 1920, p. 1300; Piwowarsky and Ebbefeld, Stahl u. Eisen, 1923, p. 967; Smalley, Foundry Trade Journal, 1923, p. 3; Merica, Foundry Trade Journal, 1924, p. 236; Donaldson, Foundry Trade Journal, 1925, p. 553; Piwowarsky, Stahl u. Eisen, 1925, p. 289; Tsuton Kase, Science Rep. Tokio; Wickenden and Vanick, A.F.A. 33, 1926, p. 347; Galibourg, Rev. d. Metall., 1927, p. 730; Oberhoffer and Piwowarsky, Die Giess., 1927, p. 585; Piwowarsky, Die Giess., 1927, p. 509; Houston, "The Foundry," 1927, No, 55, p. 399; Turner, Foundry Trade Journal, 1927, pp. 35, 59; Guillet, Galibourg and Balley, Comptes Rendus de l'Acad. d. Sciences, July 2, 1928; Everest, Foundry Trade Journal' 1928, p. 255; Everest and Hanson, Foundry Trade Journal 1928, p. 315; Piwowarsky and Freitag, Die. Giess., 1928, p. 1193 Piwowarsky and Kötzschke, Archiv., 1928, No. 5; Coyle, Metal Alloys, vol. i, 1929, No. 6, p. 272; Everest, Foundry Trade Journal, 1929, p. 45; Klingenstein, Mittl. Masch. Fabrik Esslingen, 1929, No. 4; Waehlert and Ostermann, Ni-Informationen B.I., 1929, No. 8; Schwarz, Trans. Amer. Soc. St. Treat., 1929, No. 15, p. 957; Everest, Foundry Trade Journal, 1930, No. 698, p. 8, No. 699, p. 27; Hurst, Iron Steel Ind., vol. iv, 1930, p. 91.
14 Haase, "Stahleisen," 1927, p. 2117.
15 Denecke, Die Giess., 1928, p. 307.
16 Rolfe, Iron Steel Ind., 1928. p. 208 ff.
17 Pfannenschmidt, Die Giess., 1929, p. 179.
18 Steinberg, J.S. Chem. Ind., 1928, p. 674.
19 Ballay, Rév. Met., vol. xxvi, October, 1929, p. 538.
20 Vanick and Merica, Trans. Am. Soc. Steel Treat., No. 18, 1930, pp. 923–42.
21 Müller and Hanel, Ueber austeni. Gusseisen. Chem. Fabrk., vol. v, 1932, p. 493.
22 Campion and Donaldson, Foundry Trade Journal, 1925, p. 553.
23 Smalley, Foundry Trade Journal, 1927, p. 3.
24 Smith and Aufderhaar, "Iron Age," No. 124, p. 1507.
25 Kent-Smith, "The Foundry," May 15, 1930, p. 54.
26 Musatti and Calbiani, La met. ital., 1930, p. 649.
27 Küster and Pfannenschmidt, Die. Giess., 1931, p. 53.

(To be concluded.)

Mechanised Foundries.*

By F. J. Cook, M.I.Mech.E., (Past-President).

The subject of this Paper, which has been suggested by the Literary Committee, is an important one, particularly as the foundry is the last section of engineering production to be put on a continuous or mechanised basis. Mechanisation received little attention here for a very long time after it had been applied successfully in American and Continental foundries, but it is now not only being carefully considered by foundry proprietors in this country, but is also being applied in an ever-increasing number of establishments.

Papers dealing with various aspects of this subject have already been given to the Institute. Mr. A. S. Beech read a Paper before several branches in 1930, and the French Exchange Paper presented by Mr. H. Magdelenat at the Middlesbrough Convention in 1930 described a very interesting specialised plant. The present author contributed an article on "Mechanisation of Foundries" to the Annual Review issue of THE FOUNDRY TRADE JOURNAL in January of this year. In addition, several articles dealing with some specific portion of continuous-casting plants have appeared during the last few years in technical journals.

As every installation is a special and complete problem in itself, it is difficult to lay down definite rules which would be generally applicable. Mr. V. C. Faulkner, Editor of THE FOUNDRY TRADE JOURNAL, has kindly suggested the type of information which is likely to be most useful to those of our members who are interested in mechanisation. To these suggestions the author offers the following replies.

WHEN IS A FOUNDRY WORTH MECHANISING?

No foundry is too small to benefit from some form of mechanical appliance. A man-power unit is defined as being one-tenth of a horse-power. One man power is therefore one-thirteenth of a kilowatt of electricity and at the rates at which electricity can be obtained, it is obviously more economical to use electricity wherever it is applicable, as, for instance, in supplying material to the cupola stage, lifting heavy weights in and around the foundry, running emery wheels and the like, operating the dressing shop, for the production of compressed air, and a host of other applications. But even in some of the cases cited, it is necessary to give careful thought before plant is installed; for, whilst nothing is superior to the crane for moving large and heavy material, yet for picking up and transporting small and light articles over short distances, nothing is more convenient than the human hands, and for moving similar articles over greater distances hand trucks are cheaper than cranes.

The chief requirement for a continuous mechanised plant is the production of a sufficient number of moulds to take the metal from a *continuously* worked cupola of practical size, or other continuous-melting unit. Any firm which has outgrown its premises can undoubtedly effect very large savings by introducing a continuous-casting plant in preference to enlarging them. This, of course, involves mechanisation.

For example, the proprietors of a jobbing foundry had taken on a line of work, the demand for which increased so much that larger outputs were required than appeared practicable in their existing foundry. Extensions to the buildings were impossible, and to build a new one was considered undesirable, as it would have meant removing the foundry section rather a long way from the rest of the plant. A continuous-casting system was installed, occupying only half the floor area previously employed, and although the same box-parts, pattern plates and moulding machines were used as before, the output of the foundry was increased four times, and that of the special items referred to was increased five times, although under the old conditions the output per man was well above the average obtained by foundries making similar articles.

The cost of the installation was less than one-third the cost of a new foundry capable of the same output, working under the old conditions. Among economies effected were, first, the discontinuance of a night shift for knocking out the moulds and getting up and preparing the sand; secondly, a large saving in new sand and coal dust; thirdly, lower fettling charges, due to the improved quality of the castings; and, lastly, a factor which is of as much, or more, importance than any other, and one which generally receives very little consideration, a great reduction of overhead charges. At the same time, the installation gave ample floor space for redoubling the output by the installation of a similar plant.

Special conditions will frequently require special forms of application only suitable for the particular problem or to a few installations. The perfectly-equipped foundry has not yet been produced, success being dependent on the best lay-out to meet individual requirements.

CAN MECHANISATION BE COMPLETE?

There is no such thing as complete mechanisation of a foundry, in the sense that all the work can be arranged to go on automatically. The nearest approach to complete mechanisation is the application everywhere possible of machinery to supplant hand labour, and should include in order of sequence:—Conveying the sand from the knockout, passing it over a magnet for removing all loose pieces of scrap iron, adding the necessary new sand and coal dust, riddling for mixing and for the removal of foreign matter, depositing the mixed sand in a storage hopper, taking sand from the storage hopper, passing it through mullers or other forms of preparation (including disintegrator), conveying and depositing the prepared sand into hoppers adjacent to the moulding machines. Now that the prepared sand is in a convenient position, it is passed into the moulding boxes, and moulds are prepared by one of the multitudinous methods available. After the bottom part of a mould, either by hand or by mechanical-lifting device, according to weight and size, has been put on to a small table, consisting of gravity rollers, cores are set if required, top put on, boxes clamped, and it is passed on to the mould conveyor.

This conveyor takes it to the pouring station, where the metal is poured into the mould from ladles brought by overhead runway from the cupolas. The poured moulds are carried to the knock-out station, either in the open or through a cooling tunnel, at a speed to give sufficient time for cooling, and are deposited on to knock-out grids, either stationary or mechanically vibrated, as desired. The knock-out sand falls through into the hopper below, then passes on again through the sequence previously described. After sand and castings have been removed, the empty boxes are passed back to their respective moulding machines, either on gravity roller conveyors or by replacement on the mould conveyor. Any surplus from the prepared sand conveyor and spillage around the moulding machines is passed through the floor on to a conveyor which carries it back to the sand-preparing plant, or it can be collected for use in other parts of the foundry.

Mechanised Core Shops.

Where large quantities of cores are required, such as with automobile work, it is essential that the core shop should also be mechanised by arranging for the prepared sand to be delivered to the operator, the green cores automatically carried to and through the core-drying stoves, and, after drying, on to the various stations where they are to be placed in their respective moulds.

The type and position of the various units will vary to suit the requirements of individual plants. Everything should be so arranged as to enable each operator to become a specialist in his particular part of the work. By continually performing one operation, the men soon acquire short cuts, enabling them to do the work more expeditiously and with less labour. The knock-out should be arranged in close proximity to the dressing shop, and new sand and coal-dust stores should be adjacent to the sand-preparing plant. Cupolas should be as near as possible to the pouring station, thus avoiding the necessity of carrying metal over long distances.

Turntable Machines.

The division of a sequence of operations so that each can be performed by a separate person frequently assists in obtaining greater outputs. As an example, the making of a mould by the squeeze method consists of the four operations of putting on the box part, filling the box with sand, squeezing, pattern-drawing and removing the finished mould. When these operations are performed in sequence by one attendant, the machine, whose chief function is ramming the mould, is standing whilst the other three operations are carried out. In the turntable type of machine, each of the operations is performed at one of four stations, the table turning through 90 deg. at each movement, and so in one revolution the whole four operations are completed, which means that, after the first revolution, when starting up, all four operations are taking place simultaneously. Frequently the four operations can be performed by three attendants, the one putting on the box part having time to give a hand to the one removing the mould.

The advantage of this system is more apparent as the boxes become larger; it is, therefore, an economy to have box parts as large as possible, consequently having more castings in a box. It requires as long to squeeze a small box as one, say, with four times the superficial area. This method has been further extended by carrying a number of pattern plates on a small conveyor situated inside the mould conveyor. Two or more plates are passed at a time, in sequence, past a sand-filling station and a squeezing and pattern-drawing point, the boxes being finally lifted on to the mould conveyor to be taken for casting and eventually knocking out.

A French Example.

In a plant of this description which the author had the opportunity of seeing recently in France, the pattern-plate conveyor carried 18 plates. These plates were of the split-pattern type, and therefore made nine complete moulds in one revolution. The whole of the plates contained the patterns for the various parts of a complete stove. The internal dimensions of the box parts were 32 in. wide by 42 in. long by 4 in. deep in each half.

The pattern-plate conveyor travelled intermittently in regular, defined stages equal to the length of two box parts, at one movement by means of an electric push-button. The empty box parts were placed on the pattern plates adjacent to the knock-out, and from there they passed the sand-filling station and squeezing part of the plant, etc. During the visit, records were obtained on three occasions of the time taken to fill, ram and pattern-draw four half-moulds with three men, two filling in the sand and one squeezing and drawing the pattern, and on each occasion all the operations were performed in

* Presented at the Cardiff Conference of the Institute of British Foundrymen.

less than one minute. The output for 16 hrs., *i.e.*, two 8-hr. shifts, averaged 108 complete moulds per hour. The plant had then been running only seven weeks, and it is understood that the output has now been raised to 120 complete moulds per hour.

By judicious planning and splitting up the various operations, the whole installation, including pattern and mould conveyors, knock-out and sand-preparing plant occupies a space of only 82 ft. long by 42 ft. wide.

WHAT METHODS ARE THERE AVAILABLE FOR MECHANISATION?

These can best be dealt with in sections dealing with the various parts of the plant concerned.

Cupola Charging.

As pouring begins immediately after moulding and continues throughout the day, the output per hour required from the cupola is very much less than when the whole of the pouring has to be performed in a couple of hours or so in the afternoon. It is only very large mechanised plants that necessitate anything but hand charging, but where this is desired, there is available the method of tilting skips or buckets (the tilting being performed by various methods) and the method of passing directly into the cupola a skip with a falling bottom, from which the charge drops in regular layers directly on to the preceding material.

One of the dangers of the tilting method is uneven distribution of the charge, often causing large voids and inducing oxidation. This can be somewhat obviated by the design of the shute. With the drop-bottom skip the load falls evenly in the same sequence as it is charged into the bucket. With the latter method, however, objection is sometimes taken to passing the skip and gear directly into the fumes and flame arising in the cupola. With the British Cast Iron Research Association's balanced-blast cupola, however, there is a remarkable diminution of fumes and flame above the charge, and the objection referred to is thus considerably reduced. As pouring has to start immediately after moulding is begun, it becomes desirable to have two cupolas, each working on alternate days, to allow reasonable time for patching and repairing, otherwise this work has to be carried out by a night gang.

Runways.

If the plant is well designed with the various parts in close proximity to their various supplies, nothing more than the usual overhead monorail with carriages propelled by hand is required. Where greater distances have to be covered and larger loads to be carried, as in taking the castings from knock-out to dressing shop in batches, an electrically-propelled monorail-carriage with seat for driver is to be preferred.

Sand Hoppers.

The design of these requires very special attention in order to prevent the sand sticking up and also, with hoppers over moulding machines, to prevent too great a rush of sand from taking place when filling the box-part. The more nearly vertical are the sides of the hoppers, the less is the danger of stick ups. Sharp corners or too sudden change of section should also be avoided as far as possible.

To prevent too great a rush of sand the outlet of the hopper has generally to be smaller than the cross-section of the main body and it is frequently difficult to arrange for all the sides to be vertical, especially for hoppers over the moulding machines. Square or oblong section hoppers lend themselves better for the collection of sand from the conveyor. To avoid stick-up, it is good practice to design the outlet to come near to one of the corners, thus allowing two of the sides to be practically vertical.

The discharge from the hoppers feeding the moulding machines is usually by hand-operated gates, which should be of the double-undercut type, and if hopper and gates are properly designed there should be no necessity for pneumatic rappers or any other device to cause the sand to flow properly. In some cases, and particularly for filling large moulds, on jar-ram machines, the discharge is arranged by a travelling belt, thus insuring more regular sand supply and better ramming.

One firm has adopted the very desirable method of passing sufficient sand for each operation on a travelling belt, from a main hopper to an auxiliary one, placed immediately over the moulding box. This is regulated by a push-button switch which can be timed to suit the desired requirements. The advantages are that a bigger opening can be arranged in the main hopper, and economy in sand is effected, as there is less spilling than with the ordinary gate. The discharge from the main hoppers in the sand-preparing plant is more frequently made by means of a revolving table, which allows for a round hopper with a very gentle slope to the throat. New sand and coal-dust hoppers also generally follow the same design.

It is sometimes considered advisable, particularly in large plants, to have two storage hoppers in the sand-preparing end, one to receive the knock-out sand, with its addition of new sand and coal dust, and the second one to store a quantity of the finally-prepared sand. Thus sufficient storage capacity is provided for the whole of the sand in the system at the end of a day's work and also stoppage of the whole plant is prevented when a short stop occurs in some part of the sand-preparing end. The prepared-sand hopper should carry about one hour's supply.

Sand Elevators.

Sand elevators are usually either of the rubber-faced cotton belt, or chain-link, bucket type. With the chain-link bucket type it is better to attach each side of the bucket to a chain, to prevent it from tilting when in operation, rather than to have one chain in the centre. With the belt type, the bottom or tension drums should be slatted to prevent sand packing between belt and pulley. The sand feed should be arranged to deliver the sand into the buckets and not into the boot of the elevator. Falling sand from the descending buckets should be collected by a shute and directed back to the feed point. Buckets made of malleable cast iron tend to give a better discharge and longer life, since they do not rust so much as those of pressed steel.

Ample arrangements for accessibility for replacements and attention to buckets and belts are necessary, and the top of the first elevator dealing with the hot sand from the knock-out should be fitted with a ventilating cowl to prevent accumulation of steam at this point. In some plants, inclined rubber belts instead of bucket elevators are used for elevating the sand, but the latter tend to give a much more compact lay-out.

Conveyors.

These may be divided into two classes, those employed for conveying sand to and from the sand-preparing unit and those used for conveying the moulds to the pouring and knock-out stations. There are various types available for sand-conveying from which a selection can be made to suit the different conditions existing in the various parts of the plant. Special heat-resisting rubber-faced belts can be used to receive the hot knock-out sand, these being quite satisfactory where the sand to be dealt with is not very hot. In other cases it is preferable to use a steel belt or, better still, a steel-apron plate conveyor.

There are two types of conveyor for taking the finished sand to the moulding-machine hoppers, either belts, of steel or rubber-faced canvas, or the push-plate type. Each type has strong advocates, the one being equally as satisfactory as the other as a conveyor, but it is the method of delivering the sand into the hopper that forms the contentious element.

The belt is somewhat cheaper in first cost, not necessarily in upkeep and attention. The sand is removed by ploughs scraping it off the side of the belt and dropping it into the hopper. The way into the hopper itself is often circuitous, and strong-bonded sand sometimes has a tendency to stick up in the throat and cause spilling. With the push-plate type this does not occur, as the sand drops vertically into the hopper through a hole in the bottom of the conveyor trough.

With a belt, when a hopper is full, ploughing will go on unless attended to and sand will be delivered on to adjoining platform or on to the men below, but in the push-plate type the sand is simply carried on over the full hopper and delivered into the next one or taken down the return shute at the end of the trough. Special attention needs to be paid in belt conveyors to the alignment and spacing of the support rollers or the belt will flap and balling or spilling of the sand will result.

Types of mould conveyors are: gravity rollers, chain and sprocket-driven platform, tappet-driven platform, and sprocket-chain driven pendulum. The platform type may have the pallets skidding on rails or on rollers, or running on small wheels. Those running on rollers are to be preferred to those on skids as there is less friction and wear, and consequently less power is required to drive them. The sprocket-driven platform type is usually selected with moulding machines situated outside the conveyor, thus enabling a reasonably small sprocket five to six feet in diameter to be used.

The best arrangement with the tappet-driven type is for the moulding machines to be situated inside the conveyor, this arrangement allowing a bigger radius and easier running at the ends. The tappet-driven type may be either continuous or intermittent travelling. The former are propelled by an electrically-driven belt with tappets spaced at intervals which engage on to similar tappets on the underside of the conveyor pallets, while the intermittent type has tappets fixed usually at the end of a hydraulically or pneumatically-operated ram and the strokes are controlled by hand at convenient intervals.

The pendulum type lends itself readily to irregular contours of track, either in the vertical or horizontal planes. In the continuous-travelling conveyors provision should always be made to allow for altering the speed of travel preferably whilst at work. The gravity roller hand-operated tracks are suitable for small installations and where small capital outlay is considered essential.

The overall widths of plants with moulding machines placed either inside or outside the tracks is usually about the same, but where the plant has to be installed in existing buildings it is sometimes found that the narrow sprocket-driven tracks allow better space at the pouring part of the system.

Sand-Preparing Plants.

The routine of operations in this part of the system is more or less the same in all types and is enumerated in the first part of this Paper. The variations that do occur are usually in plants requiring separately-prepared facing sand and where more mulling of the sand is required than can usually be obtained by continuously-working mills. To give a more regular supply of prepared sand, in the latter system, it is essential to employ two mills, so that no one can be discharging whilst the other is mulling. A measuring device for the sand going into the mills tends to a more consistent quality of product.

Separate facing sand is sometimes found essential from an economical point of view, where synthetically-bonded sands have to be used, but in this country with a liberal supply of natural sand the necessity does not arise and it is therefore found more economical to put all the sand, both facing and backing, through the same operation. The mills are a very important part of

the system. There are several British and Continental makes which have outstanding qualities for mechanised plants. Many of the Continental types have excellent mixing arrangements, but with the British sands would give better bonding results if the rollers were heavier.

Knock-out Details.

The knock-out arrangement calls for a different type with nearly every layout and is governed largely by the class of work being made. It may vary from ploughing the moulds from the conveyor, in the case of snap-flask work, removing them by hand, with or without levers, in the case of small and medium size boxes, and pneumatic push-offs with large and heavy moulds. The sand is removed from medium and small moulds by bumping and from the large moulds by placing them on a vibrating frame, in each case the sand falling through a grating into the knock-out sand hopper below.

Core Stoves.

As the requirements of the core-making part of the establishment is so very varied, both as to quantity and type of work required, it is difficult to give any more than the general items mentioned in the previous part of this Paper. In connection with the core stoves, however, there seems to be a very determined partiality shown to the vertical continuous-travelling core stove instead of the previously-used horizontal stove in which the cores were passed through on pendulum conveyors.

The vertical stove has many advantages, not the least of which is the small floor space required and lower power necessary for driving. They are also very applicable for use with coke forced-draft firing, although gas can also be employed. That, however, is very expensive in comparison. As the stoves are very well insulated, no inconvenience is experienced by those at work in this vicinity.

Advantages of Mechanisation.

The advantages of mechanisation obtained by the installation of mechanised plants are many. The regular and steady flow of both materials and products tends not only to give a more orderly foundry but to organised arrangements being made so that at the end of the day practically all the work is ready for despatch. In extremely busy periods it is easier to arrange for double shifts without any delays in output due to floors having to be cleared of poured moulds. Night shifts to clear up are not required. As castings are ready for inspection very soon after starting up, any defects are immediately found out and steps can be taken to eliminate them, instead of a whole day's work being spoilt owing to a defect not being observed till the next day. It is possible to standardise more definitely on box-parts, for any little variation in the volume of sand to be used for different jobs does not have such a material effect upon moulding costs. Continuous use of box-parts greatly decreases the number required, so that very large savings are obtained on this account alone. Big economies in moulding are effected, as the moulder spends the whole of his time producing moulds instead of 75 per cent. of his time being taken up with general labouring. Floor space required for a given output is enormously reduced, thereby effecting a very big saving in overhead charges. The work being split up, every attendant on the plant soon becomes an expert in his own part of the system, whilst at the same time it is easier to replace one who may be absent. Continuous pouring requires less men on this part of the work than when it has to be done over a couple of hours or so in the afternoon. Carrying the metal to one point for pouring instead of to every part of the foundry is not the least item of convenience or economy. All castings are collected at one point, eliminating collection and carrying around the entire foundry. The quantity of new sand and coal dust required is much reduced, as the castings are removed in the shortest possible cooling time. Continuous-working speeds up production and sets up a pace which can moreover be maintained since the break-back work is eliminated.

The author feels that to convey a full comprehension of the values of mechanisation it would be necessary to give an enormous quantity of illustrations. He hopes, however, in some measure to remedy this defect in the paper by showing some lantern slides and cinematograph films when the Paper is read.

In this connection the author's thanks are due, and hereby tendered, to Mr. A. W. G. Bagshawe, of Bagshawe & Company, Limited, Dunstable; Mr. A. S. Beech, of Foundry Equipment, Limited, London; Mr. H. F. Coggon, of Augusts, Limited, Halifax; Mr. W. H. Smith, of the Foundry & Engineering Company, Limited, West Bromwich; and Herbert Morris, Limited, Loughborough.

The Handling of Refractories.

The importance of close, tight brickwork in furnace construction is now being appreciated both by the maker and by the user of refractories. When the manufacturer has spared no pains during the making and burning, and in the despatching of goods, to ensure that accuracy of sizes and excellency of shape are maintained, it is vexatious to see unnecessarily rough and unsympathetic handling nullifying all the efforts put forth to achieve good results. In some cases the unloading of bricks is considered unimportant and only suitable for odd casual labour without supervision. The handling of bricks, however, should always be supervised, for it is in the user's own interest to see that bricks are treated with respect.

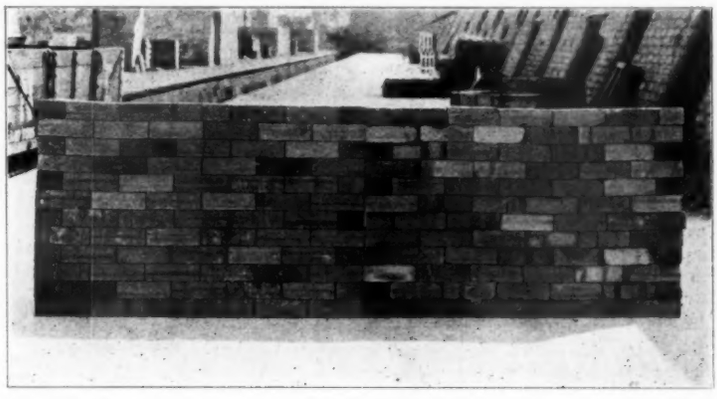


Fig. 1.—Showing the Effect of Maltreating Firebricks during Handling.

Refractories, especially firebricks, are usually regarded as tough and robust materials, but it is necessary to remember that they possess inherent brittleness in consequence of their being partially vitrified bodies containing varying amounts of glassy material. Bricks which are roughly or carelessly handled are bound to lose chips and corners. A certain amount of chippage is inevitable, but it is surprising how a little care in handling can reduce the chippage to a minimum. The use of rubber-tyred wheelbarrows is a great advantage, as it eliminates excessive jolting, especially when crossing rails and uneven surfaces, apart from their being much easier to use than the old-fashioned barrows with steel tyres.

Fig. 1 illustrates walls built up of two lots of the same brand of firebrick. One lot was the normal run of brick taken by hand from a wagon while the other was thrown from a wagon on to a cement floor. It does not require much imagination to see that such bricks could be the sources of serious trouble in furnace work, for even a few bricks without corners may be the cause of an expensive, premature failure. Careful handling, therefore, is an insurance and a real economy.

In this country the general practice is to send standard sizes and most shapes of both firebricks and silica bricks loose in the railway truck, carefully packed to prevent movement and rubbing in transit. Experience has shown that this method is perfectly satisfactory providing ordinary care is taken by the railway company in their shunting operations. For the export market special shapes should always be packed. Standard sizes are generally shipped loose, although there is a growing tendency to ship these packed also. The circumstances vary to some extent, depending on the number of handlings involved and the amount and nature of labour available. With high-grade materials, however, it should prove economical in many cases to pack the bricks.

Iron in the Early Ages.

In a recent letter to "The Times" Dr. Cecil H. Desch, F.R.S., of the National Physical Laboratory, Teddington, Middlesex, states:—"In the course of the excavations at Tell Asmar, described by Dr. Frankfort in "The Times" of July 10 and 11, a hoard of copper objects was found, enclosed in a pot. Through the kindness of Dr. Frankfort, I have had an opportunity of examining certain of these objects. Among them was a bronze open-work dagger handle, in the slot of which was still wedged a fragment of material, evidently derived from the original blade. A lump of similar material was loose inside the handle, being too large to fall through the perforations. On analysis this material proved to be rusted iron, converted as usual by long contact with the earth into a hard, magnetic, crystalline mass. The position in which it was found leaves no doubt that the blade of the dagger was of iron. Moreover, analysis shows that this iron is free from nickel, and is therefore not of meteoritic origin.

"The find is stated to be of the same period as those at Ur and Kish. Among the objects found by Mr. Woolley in the Royal Tombs at Ur was a single object of iron, a small axe, which the writer was able to show had been forged from a meteorite. This was proved by analysis and by microscopical examination of a still unrusted portion of metal. Other iron objects of early date have also been proved, by their high content of nickel, to have been made from meteorites. The occurrence of an iron object of terrestrial origin at such an early date is most striking, and of the first importance for the history of ancient metallurgy."

Cold-rolling Rolls.—In the "Kalt-Walz-Welt," E. Schreiber describes the manufacture and handling of rolls for cold-rolling work.

Report on Routine Methods for Testing Green Sands.

BY THE SANDS AND REFRACTORIES SUB-COMMITTEE OF THE INSTITUTE OF BRITISH FOUNDRYMEN.

(*Concluded from page 56.*)

SYNOPSIS OF PAPER.

The committee has investigated routine methods of testing green sands for:—(1) Moisture; (2) permeability, and (3) bond strength. The method recommended for moisture is that known as the "Speedy" (British patent No. 33985), which depends on mixing a weighed quantity of sand with powdered calcium carbide in a closed container and reading the pressure generated through the liberation of acetylene gas.

The dimension of various test-pieces both for determining permeability and bond strength are discussed. But the decision as to whether the A.F.A. 2 in. dia. by 2 in. long, or the B.C.I.R.A. 1.128 in. dia. by 2.256 in. long is not yet decided, though there is some advantage in using a test-piece of large dimensions especially for weak sand. A satisfactory relationship has been found between permeability and bond-strength tests made when using the different test-pieces.

Permeability may be satisfactorily measured on either the A.F.A. Standard apparatus, Richardson's Modification (in which pressures only can be measured), or the B.C.I.R.A. apparatus—preferably the new modified design for foundries having no gas supplies.

It is recommended that the bond strength should be determined by means of a compression test, and whilst several designs are acceptable, the B.C.I.R.A. new modified design, which is the only one known to be made in Great Britain, is regarded as satisfactory.

APPENDIX A.

Determination of Permeability in Green Moulding Sands by the A.F.A. Standard Method.

Ramming the Specimen.—Place the pedestal B (Fig. 1) in the end of the tube A (6-in. by 2-in. bore) and find by trial the weight of sand which is necessary to form a rammed specimen 2 in. dia. and 2 in. long plus or minus a tolerance of $\frac{1}{16}$ in. Usually between 140 and 180 grms. are required. After placing the sand—weighed to the nearest gram—in the tube A with pedestal in position, shake it lightly down. Lift the rammer-rod D and place the pedestal with the tube under the rammer so that the rod D rests on the top of the sand, then turn the cranked handle E three times in order to allow the 14-lb. weight to be lifted 2 in. and dropped on to the ram-rod collar thrice.

Note whether the upper end of the ram rod is within the tolerance marks at O at the top of the frame. If it is not, reject the specimen and start again with a greater or less weight of the sand according to what is judged necessary to ram a specimen of the correct length.

The correct length can be found usually with not more than three trials. When the ramming is satisfactorily completed, remove the pedestal and tube from the rammer after raising the rammer by means of the handle I.

Determination of Permeability.—Before using the apparatus (Fig. 2) the tank D should be filled with water to within about 5 in. of the top. Fill the manometer tube E with coloured water to the zero mark about half-way up its length. Take away the pedestal B (Fig. 1) and place the tube in the trough A (Fig. 2) with mercury seal, at the foot of the permeability apparatus. Turn the tap B to position marked "vent," raise the bell C until the mark X is visible, then turn B to the "off" position. In order to determine the permeability, have a stop-watch or ordinary watch with seconds hand ready, then turn tap B to the "on" position and as the bell C descends note the time when the mark O passes the top edge of the tank D and again when the mark 2L passes the top edge of the tank. The time required indicates the period during which 2 litres of air are forced through the sand specimen.

Whilst the bell is falling, the pressure on the manometer should be noted and recorded to the nearest mm. This reading in cm. = "grams pressure" (per sq. cm.) since 1 c.c. of water weighs 1 gram (approx.). If the sand is very dense the time required to pass 1 litre of air through the specimen may be observed and a weight may be placed on the bell so as to shorten the time and raise the pressure. In any event, it is not desirable to work at a lower pressure than about 5 cm.

$$\text{Permeability} = \frac{\text{c.c. of air} \times \text{cm. height of specimen}}{\text{sq. cm. area of specimen} \times \text{grms. pressure} \times \text{mins.}}$$

Since the volume of air is 2,000 c.c., the height of the A.F.A. specimen 5.08 cm. and its area 20.268 sq. cm.

Substituting these constants:—

$$\frac{2{,}000 \times 5.08}{20.268 \times \text{grms. pressure} \times \text{mins.}} = \frac{501.2}{\text{grms. pressure} \times \text{mins.}}$$

or

$$\frac{30{,}072}{\text{grms. pressure} \times \text{secs.}}$$

APPENDIX B.

Determination of Permeability in Richardson's Apparatus.

Before proceeding with the test see that the apparatus is standing quite level on the bench. Ram the specimen by the A.F.A. method as described in Appendix A or by the B.C.I.R.A. method as modified by Buchanan.

Open tap, S (Fig. 9), leading to the U-tube. Place the sand container, N, containing rammed specimen, M, in the trough, L, with mercury seal. Open the tap, F, and run water into the tank, A, through the hole, C, until it flows down the fall pipe, E, and into the tank, B, and overflows at H, when the tap is opened. Shut-off tap, F, and when the water has drained from tap, H, it should be closed. The level of the water in tank, B, should then correspond with a point on the water gauge about one or two inches below the mark J. Water is allowed to continue to run into the top tank, A, until it just begins to overflow at D. The water is turned off, and the overflow allowed to drain. The coloured water in the U-tube should be adjusted to the zero mark on the scale at R, before the sand container, N, is placed in the trough L.

The mark K, higher up the water gauge in tank, B, represents the point at which exactly two litres of water will flow from the top tank when commencing at the mark J. All is now ready for measuring the permeability. The operator should have a stop-watch or a watch with a seconds hand ready for observation.

Quickly open the tap, F, and as the water flows into B, and rises up the water-gauge, note the time when the water passes the level, J, and again when the water reaches the level, K. The moment the water reaches K, close the tap, S, so that the position of the water in the U-tube is fixed. By means of a sliding scale, measure the difference in height in centimetres between the water levels in each limb. Having taken the time in seconds for two litres of air to be forced through the specimen, and noted the pressure on the water gauge, the permeability is calculated in exactly the same way as is described in Appendix A when using the A.F.A. apparatus. For routine purposes if it is desired to measure the pressure only, the time should be measured in the first place for each kind of sand and then assumed to be a constant. This means that for such purposes the permeability aimed at is represented by a certain water pressure, for example, say 30 centimetres, using a $\frac{3}{16}$-in. nozzle.

The height of the column of water in the U-tube is approximately inversely proportional to the permeability of the sand. For example, a standard-rammed sand yielding a pressure of 20 centimetres head of water is approximately twice as permeable as a sand showing a pressure of 40 centimetres head of water.

To repeat the test, open tap, S, and remove the cylinder, N, then open tap, H, and allow water to drain as far as possible from tank B. Replace the cylinder in trough, L, and run water into tank, A, until it overflows, and drains at D. All is now ready for re-measuring the permeability by opening tap, F, and timing the flow of water from J to K, whilst at the same time closing tap, S, just when the water reaches K.

A series of nozzles is supplied with holes of the following exact diameters:—$\frac{1}{4}$ in., $\frac{3}{16}$ in., $\frac{5}{32}$ in., $\frac{1}{8}$ in. The user will find which nozzles are the most suitable for his range of sands. These are likely to be either the $\frac{1}{4}$-in. or the $\frac{3}{16}$-in. It is desirable to use a nozzle which will show as high a reading as possible on the water gauge when testing the densest sand likely to be met with.

BIBLIOGRAPHY OF REFERENCES.

1 Trans. A.F.A., Vol. XXIII, p. 749.
2 Trans. A.F.A., Vol. XXXII (Part 2), pp. 9 and 12.
3 Foundry Trades Journal, December 15, 1932, p. 362.
4 Trans. A.F.A., also Proc. I.B.F., Vol. XXI, pp. 277–8.
5 B.C.I.R.A. Bulletin.
6 A.F.A. publication "Testing and Grading Foundry Sands," March, 1931, edition.
7 Proc. I.B.F., Vol. XXV, pp. 567–569, 590, 593–4.
8 B.C.I.R.A. Research Report No. 73, May, 1930, edition, pp. 26–28.
9 Trans. A.F.A., Vol. XXXII, part 2, 1925, pp. 26–28; Vol. XXXIV, 1926, p. 404 *et seq.*; Vol. XXXVI, 1928, p. 235 *et seq.*; "The Materials of Construction," by J. B. Johnson (U.S.A.), p. 28, etc.
10 Proc. I.B.F., Vol. XXV, pp. 590, 593–4.

Cast-iron Drain Pipes.—The British Standards Institution has just issued British Standard Specifications—No. 437, 1933, cast-iron spigot and socket drain pipes, and No. 493, 1933, cast-iron airbricks and gratings. Specification No. 437 supersedes the first edition issued as B.S.S. No. 437, 1933. Certain anomalies which were found to exist in the minimum weights of the pipes have been corrected and a revised table has been inserted. B.S.S. No. 493, Part I, provides for the essential requirements of cast-iron airbricks and gratings, *i.e.*, quality of material, dimensions and minimum weights, total unobstructed area and the minimum size of apertures. Part II gives British Standard patterns which comply with the requirements of Part I. These specifications can be obtained from the Publications Department, British Standards Institution, 28, Victoria Street, London, S.W.1 (Price each 2s. 2d. post free.)

Barrow Handles.—At works which use a great many ordinary wheelbarrows employees sometimes have their hands and fingers crushed in passing through doorways. Handguards of flat metal strip have been tried, but they are not entirely successful. Men have knocked them so hard that they bent the metal down on to their hands. In such cases it is recommended to try annular pieces of strong sheet metal. The inside diameter should be such that the disc will slip over a barrow handle as far as the front of the hand grip. The metal should stand out about 2 in. all round, and at right angles to the handle. We are informed that, when probably made and fitted, these guards are very strong and have not the disadvantages associated with handguards of flat metal strip.

Institute of Metals.

SILVER JUBILEE AUTUMN MEETING AT BIRMINGHAM.

As already announced, the twenty-fifth autumn meeting of the Institute of Metals will be held in Birmingham from September 18 to 21. The opening session will be held in the evening of Monday, September 18, in the Medical Theatre, The University, Edmund Street, when Mr. W. R. Barclay, O.B.E. (Vice-President) will deliver the twelfth autumn lecture, which will be on the subject of "Twenty-Five Years' Progress in Metallurgical Plant."

On the following morning there will be a general meeting of members in the Examination Hall of the Central Technical College, Suffolk Street, and a Civic welcome will be given to the members by the Lord Mayor of Birmingham (Councillor H. E. Goodby). Papers will be presented for discussion. Later there will be a luncheon and works visits, and, in the evening, a reception by the University of Birmingham, University Road, Edgbaston, followed by a dance in the Great Hall. The original office of the Institute, which was in the Metallurgical Museum, will, so far as possible, be reconstructed, and there will be an informal gathering of original members only, who will be welcomed by the President of the Institute, the Chairman of the Local Reception Committee, the Chairman of the Executive Committee, and the Secretary of the Institute.

On Wednesday the remaining Papers will be presented for discussion. In the afternoon a number of works will be visited, and in the evening there will be a Civic Reception by the Lord Mayor and Lady Mayoress at the Council House, when there will be music, dancing, and entertainment. Finally, on Thursday, there will be an optional whole-day excursion by motor coach to the Cotswolds.

List of Papers for Autumn Meeting.

"The Constitution of the Silver-Rich Aluminium-Silver Alloys," by N. W. Ageew, Met.Eng., and D. N. Shoyket, Chem.Eng.

"Experiments in Wire-Drawing. Part III.—Annealing of High-Conductivity Copper Wires Drawn to Varying Degrees of Hardness," by W. E. Alkins, M.Sc., and W. Cartwright, O.B.E., M.Sc.

"Further Observations on the Distribution of Porosity in Aluminium and Copper Ingots, with Some Notes on Inverse Segregation," by N. P. Allen, M.Met.

"Magnesium Alloy Protection by Selenium and Other Coating Processes. Part II," by G. D. Bengough, D.Sc., M.A., and L. Whitby, M.Sc.

"The Properties of Some Temper-Hardening Copper Alloys Containing Additions of Nickel and Aluminium," by H. W. Brownsdon, M.Sc., Ph.D., Maurice Cook, M.Sc., Ph.D., and H. J. Miller, M.Sc.

"Corrosion-Fatigue Characteristics of an Aluminium Specimen Consisting of Two Crystals," by H. J. Gough, M.B.E., D.Sc., Ph.D., and D. G. Sopwith, B.Sc.Tech.

"Wear in the Polishing of Plated and Other Surfaces," by O. F. Hudson, A.R.C.S., D.Sc.

"A Graphical Method for Converting the Weight Percentage Compositions of Ternary Systems into Atomic or Molecular Percentages," by W. Hume-Rothery, M.A., Ph.D.

"Notes on the Preparation of Lead and Lead Alloys for Microscopic Examination," by Brinley Jones, M.Met.

"Precipitation-Hardening Nickel-Copper Alloys Containing Aluminium," by D. G. Jones, M.Sc., L. B. Pfeil, D.Sc., A.R.S.M., and W. T. Griffiths, M.Sc.

"An Investigation of the Heat-Treatment of Standard Silver," by Hugh O'Neill, M.Met., D.Sc., G. S. Farnham, B.A., M.Sc., and J. F. B. Jackson, B.Sc.

"Some Steps in Metallurgical Progress, 1908-1933," by W. Rosenhain, B.A., D.Sc., F.Inst.Met., F.R.S.

"The Constitution of the Aluminium-Rich Aluminium-Copper Alloys above 400 deg. C.," by D. Stockdale, M.A., Ph.D.

"Note on the Green Patina on Copper: Examples from Elan Valley (Wales) and Dundalk (Ireland)," by W. H. J. Vernon, D.Sc., Ph.D.

British Cast Iron Research Association.

ELECTS NEW MEMBERS.

The following firms have joined the British Cast Iron Research Association. In brackets we give the name of their accredited representative.

As Ordinary Members:—

Dartmouth Auto Castings, Limited, Smethwick (Mr. W. Sawyer); D. Gestetner, Limited, London (Mr. H. C. Marshall); J. and E. Hall, Limited, Dartmouth (Mr. A. E. McRae Smith, M.A.); John M. Henderson & Company, Limited, Aberdeen (Mr. R. T. Medd); R. A. Lister & Company, Limited, Dursley, Glos. (Mr. F. H. Lister); H. V. McKay, Massey Harris Pty., Limited, Sunshine, Australia (Mr. D. B. Ferguson); John Ruscoe & Company, Limited, Hyde (Mr. G. H. Kenyon, M.Sc.); Russell Manufacturing Company Pty., Limited, Melbourne, Australia (Mr. R. G. Russell); Ruston & Hornsby, Limited, Lincoln (Mr. R. C. Shepherd); George Salter & Company, Limited, West Bromwich (Mr. J. W. Bache); Stewarts and Lloyds, Limited, London (Mr. S. C. E. Lloyd); G. & R. Thomas, Limited (Mr. W. Musgrove).

As Trade Associations:—

Manchester & District Ironfounders Employers' Association, Manchester (Mr. A. Hodgkinson); North of England Ironfounders' Association, Newcastle (Mr. J. Smith).

As Trade Members:—

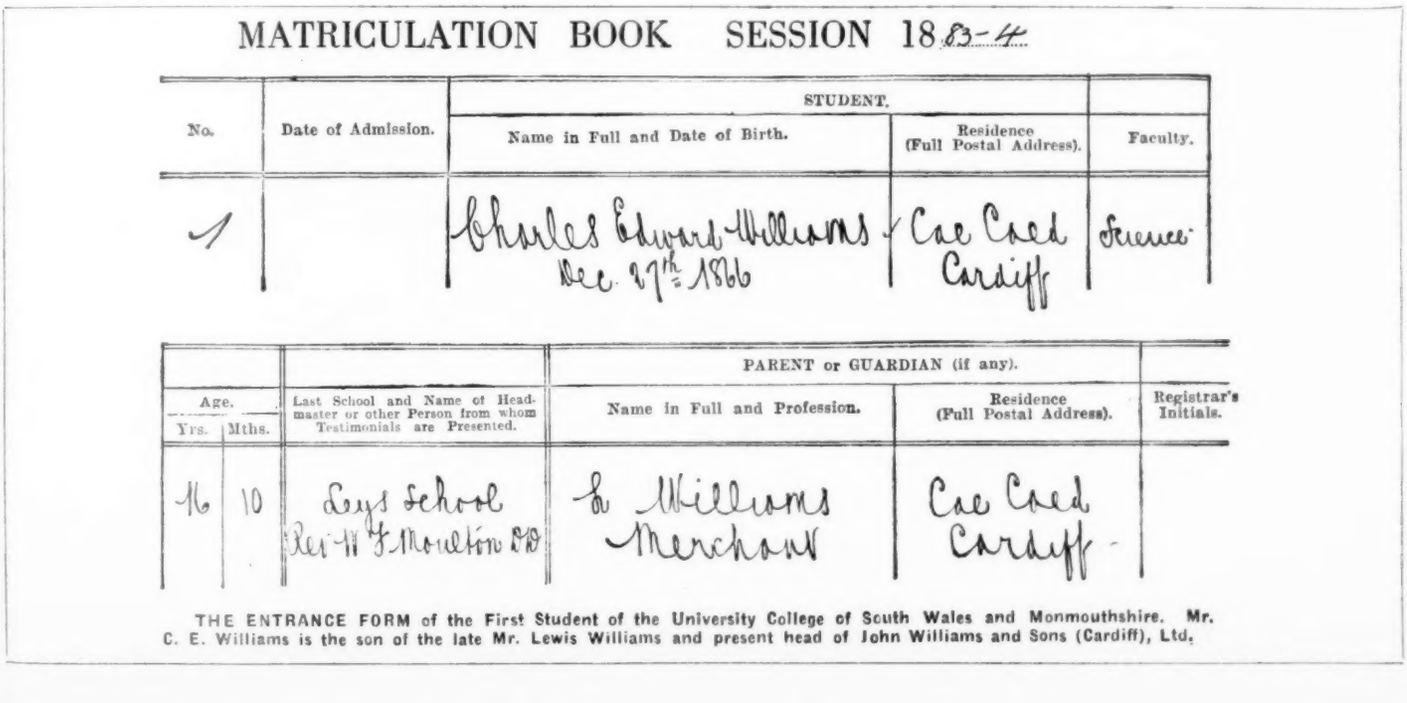
Bearpark Coal & Coke Company, Limited, Middlesbrough (Mr. J. H. Atkinson); J. Parish & Company, Erith (Mr. J. N. Talbot); Plean Colliery Company, Limited, Plean, Stirlingshire (Mr. T. H. Thorneycroft).

As an Associate Member:—

Mr. W. J. P. Riley, Birmingham.

Student Number One.

At the recent Cardiff Conference of the Institute of British Foundrymen appreciative reference was made by the University and Civic Authorities to the fact that the Institute's president was the first student to be enrolled in the local University College at its establishment. We are indebted to the Editor of the "Western Mail" for permission to reproduce a photograph of the entrance-form of the first student, and in doing so trust that Mr. Williams will forgive us for broadcasting his age, about which no little controversy arose at the time of the recent Conference.



MATRICULATION BOOK SESSION 1883-4

No.	Date of Admission.	STUDENT. Name in Full and Date of Birth.	Residence (Full Postal Address).	Faculty.
1		Charles Edward Williams Dec. 27th 1866	Cae Coed Cardiff	Science

Age. Yrs.	Age. Mths.	Last School and Name of Headmaster or other Person from whom Testimonials are Presented.	PARENT or GUARDIAN (if any). Name in Full and Profession.	Residence (Full Postal Address).	Registrar's Initials.
16	10	Leys School Rev. W. F. Moulton DD	J. Williams Merchant	Cae Coed Cardiff	

THE ENTRANCE FORM of the First Student of the University College of South Wales and Monmouthshire. Mr. C. E. Williams is the son of the late Mr. Lewis Williams and present head of John Williams and Sons (Cardiff), Ltd.

This Week's News in Brief.

Trade Talk.

Imperial Chemical Industries, Limited, are to extend their alkali works at Winnington, Northwich. It is also learned that they have made a formal offer for the acquisition of the Chemical & Metallurgical Corporation, Limited, by an exchange of shares.

Messrs. Samuel Fox & Company, Limited, announce that their Stocksbridge Works will be closed from 12 noon on Saturday, August 5, until 8 a.m. on Monday, August 14.

Mr. T. D. Morgan, Glaisdale, Porthcawl, has been appointed agent for Wild-Barfield Electric Furnaces, Limited, and G.W.B. Electric Furnaces, Limited, for South Wales and the West of England.

The new cruiser "Achilles," built by Messrs. Cammell Laird & Company, Limited, Birkenhead, is in the Clyde carrying out trials. The "Achilles" was built under the 1930 Admiralty programme.

It has been officially announced by the Ayrshire Dockyard Company, Limited, that they will concentrate on ship-repairing work and that the construction of new vessels will be discontinued at their Irvine yard.

Tests are being made at Tesin, Silesia, and at Ostrava, Moravia, with the "Schmid" system of iron road pavements, the honeycomb cast-iron blocks for which have been supplied by the Czecho-Slovak Coal & Iron Company.

The registered office of the Darlington Rustless Steel & Iron Company, Limited, has been removed to 91, Moorgate, London, E.C.2, and Messrs. D. Macdonald Browne & Company have been appointed secretaries and registrars.

The Aberdulais Tinplate Works, Neath, which have been idle for some time, were reopened on July 24. The management of the Cardonnel Tinplate Works, Skewen, have decided to make a restart in the second week in August, after an idle period of some twenty months.

At a recent meeting of the Fife County Council it was announced by Lord Elgin that in connection with the improvement of the ferry service at Queensferry an order was being placed with Messrs. Denny Bros. & Company, Limited, Dumbarton, for the building of two new ferry boats.

The partnership between Messrs. A. Hopkins and J. W. Webster, carrying on business as aluminium and brass founders at the Sidney Foundry, 16, Hazelville Road, London, N.19, has been dissolved by mutual consent. The business will be carried on in the future by Mr. A. Hopkins.

A new vessel for Messrs. Jamaican Banana Association is to be built by Messrs. Lithgows, Limited, Port Glasgow. The vessel will be larger than the banana vessels "Pioneer" and "Progress," previously built by Messrs. Lithgow, and it will be constructed to suit both fruit and passenger services.

Messrs. Lithgows, Limited, Port Glasgow, have launched the "Arakaka," which they have built for Messrs. Booker Bros., M'Connell & Company, Limited, Liverpool, for their special trade between Britain and Demerara. The vessel is of 2,450 tons gross and will be fitted with triple-expansion engines supplied by Messrs. David Rowan & Company, Limited, Glasgow.

A new issue of £500,000 of 4 per cent. debenture stock, repayable in 1958, has been made privately by the Stanton Ironworks Company, Limited. Application will be made to the Committee of the Stock Exchange, London, for permission to deal in the stock and for an official quotation. The proceeds of the issue will be applied towards the financing of further capital development and the general purposes of the company.

Messrs. Workman Clark (1928), Limited, Belfast, have contracted to build a passenger and cargo motorship for Messrs. Andrew Weir & Company, Limited, Glasgow. The new vessel, which will be named "Incomati," will be rather larger than the two motorships "Inchango" and "Isipingo" which Messrs. Workman Clark have at present under construction, and which are nearing completion; these are each of 6,800 tons gross, intended for the owners' trade between India and East Africa, the first to be launched in September and the second in October. The new vessel will be about 7,000 tons gross and her construction will be proceeded with immediately.

An interesting application of a large petrol engine to the driving of electrical-generating plant is illustrated by the 100-k.v.a. standby motor-alternator supplied to the Congells Power Station, Durban. The engine is the "straight-eight" type made by the Parsons Oil Engine Company, Limited, of Southampton, and is known as the M8S. The cylinders are 4¾ in. by 6 in., giving a minimum of 150 h.p. at 1,500 r.p.m. continuously. The alternator is of the standard G.E.C. three-phase, revolving-armature type, made by the General Electric Company, Limited, and is rated at 100 k.v.a., 390 volts, 50 cycles, when running at 1,500 r.p.m. The machine is fitted with two oil-ring lubricated pedestal bearings and is direct coupled to its exciter.

The report of the directors of the Indian Iron & Steel Company, Limited, for the year ended March 31 last, states that the production of pig-iron and by-products was on a restricted scale throughout the year. Stocks of pig-iron have been reduced to a minimum. Stocks of raw materials remain at the lowest point consistent with the safe operation of the works. Every possible economy has been effected in the management of the works. The world's markets for pig-iron continue to be unsatisfactory and tariff walls make sales exceedingly difficult to effect. Shipments continue to Japan, but at unsatisfactory prices. The Ottawa Agreement is operating satisfactorily. The outlook for the coming year is obscure, but the directors anticipate that it will be possible to continue operations on a restricted scale.

Company Reports.

Richard Thomas & Company, Limited.—Trading profit, £294,833; interest charges, depreciation, etc., £183,393; net profit, £111,440; brought in, £222,133; carried forward, £333,573.

Indian Iron & Steel Company, Limited.—Loss in year to March 31 last, after allowing depreciation and charges on the 7½ per cent. debenture loan, Rs. 40,564. The deficit to go forward is Rs. 18,956, after crediting Rs. 21,608 brought in.

Vickers, Limited.—Interim dividends for the half-year ended June 30 of 2½ per cent. on the preferred 5 per cent. stock, less tax; 2½ per cent. on the 5 per cent. preference shares, less tax, and 2½ per cent. on the cumulative preference shares, free of tax.

Warner & Company, Limited.—Profit, £3,444; appreciation in value of investments, £2,051; brought in, £399; preference dividend, £2,025; income tax and fees, £999; dividend on the ordinary shares of 5 per cent., £1,500; depreciation, £1,000; carried forward, £370.

S. P. Austin & Son, Limited.—Brought in, £282; income from investments, £5,691; transferred from general reserve, £4,500; loss on trading, £2,181; interest on debentures, £2,800; depreciation, £1,250; carried forward after payment of interim dividend on preference shares, £92.

N.C. Metal Company, Limited.—Balance-sheet, as at December 31 last, shows an increase in the year of £5,655 to £123,364 in the amount standing to the debit of research and development account. This increase represents the excess of general expenses and other charges over royalty receipts, etc.

Company Meeting.

Broughton Copper Company, Limited.

Presiding at the annual meeting of the Broughton Copper Company, Limited, Vice-Admiral Sir Robert B. Dixon said that they had passed through a year of trade depression unequalled in the memory of any of those present. The total volume of orders available in this country for such articles as were manufactured by their company showed a considerable diminution compared with the preceding year. Restrictions to overseas trade in the shape of depreciated currencies and tariffs had been intensified, and competition, both from home and abroad, had so increased that the average margin between selling prices of these manufactured products and metal costs showed a further substantial decline. Though a tariff was imposed on most of the foreign goods entering this country, the duty on manufactured copper was only 10 per cent. This was too small to be of any real advantage to the industry, particularly having regard to the cheap Continental labour with which British manufacturers had to compete.

Personal.

Mr. H. A. A. While, of Wolverhampton, has been appointed assistant to Mr. R. Crichton, director and general manager of the Workington Works of the United Steel Companies, Limited.

Mr. Maurice Olivier has been elected President of the French Foundry Employers' Federation. Mr. Olivier is the President of the North and North-Eastern local association. Mr. Charles Dufour, who has been President of the Federation for 14 years, has been elected Honorary President.

Mr. Cecil Charles Andrew, who until recently was employed in the sales department of Messrs. Craven Bros. (Manchester), Limited, at Reddish, has joined the staff of their South African agents in Johannesburg, Messrs. Rogers-Jenkins & Company (Pty.), Limited, with whom he will work in the capacity of "Craven" machine-tool expert.

Wills.

Lund, T. P., of Keighley, retired iron-founder £18,862

Mather, Colin, of Prestwich, Manchester, formerly a partner in Messrs. Mather & Platt, Limited, engineers £23,604

Jackson, C. M., of Polmadie, Glasgow, managing director of Messrs. J. H. Carruthers & Company, Limited, engineers £102,128

Contracts Open.

Bradford, August 10.—Iron and steel stores, for the Gas Committee. Mr. E. Crowther, gas engineer, Town Hall.

Johannesburg, August 28.—Brass piping, brass sheet and copper sheet, for the South African Railways and Harbour Administration. The Department of Overseas Trade, 35, Old Queen Street, S.W.1. (Reference G.Y. 12,789.)

London, August 17.—Loose jaws for fastening rails to metal sleepers, for the Bombay, Baroda & Central India Railway Company. Mr. S. G. S. Young, secretary, The White Mansion, 91, Petty France, Westminster, S.W.1. (Fee 10s., non-returnable.)

Dublin, August 12.—Supply and erection of sewerage pumping plant, including electric motors, for the Dublin Board of Public Health. Mr. P. H. McCarthy, 26, Lower Lesson Street, Dublin. (Fee 10s., non-returnable.)

Kingsclere, August 8.—The following works in connection with a water-supply scheme, for the Kingsclere and Whitchurch Rural District Council:—(Contract No. 2) 3-in. and 4-in. cast-iron mains, with valves, hydrants, fountains and other works; (3) 50,000 gallons capacity mass concrete reservoir and valves, pipework, etc., and (4) erection of small pump-house. Mr. Guthrie Allsebrook, engineer, 29, Crown Street, Reading. (Fee £1 1s. for each section, returnable.)

Obituary.

Mr. James Hunter, of Glengarnock, a contractor in the Glengarnock steel and iron works of Messrs. Colvilles, Limited, has died at the age of 55.

We regret to announce the death of Mr. John Rolland, of Messrs. J. Rolland & Company, engineers, Abbey House, 2, Victoria Street, London, S.W.1, which occurred on July 27.

The death is reported from America of Mr. William Acheson Smith, President of the Acheson Graphite Corporation. Mr. Smith, who was a Past-President of the American Electro-Chemical Society for many years, directed the manufacturing plant at Niagara Falls.

Mr. A. B. Burton, proprietor of the Thames Ditton bronze foundry which is famous for large sculptural works, died recently at his home at Thames Ditton, Surrey. The Quadriga designed by Captain Adrian Jones, and placed on Decimus Burton's arch at the top of Constitution Hill, was cast in his foundry. The "Peter Pan" statue in Kensington Gardens, the Liverpool replica of the "Piccadilly Eros," the bronzes of King Edward and Queen Alexandra for New Delhi, and many other famous memorials in all parts of the world also came from Mr. A. B. Burton's foundry. One of his latest castings was the memorial to Queen Alexandra in the wall of Marlborough House.

FRODAIR ALLMINE PIGIRON

(Customer's photograph)

for

Cylinder Blocks,
Pistons, and Rings.

BEST AFTER TEST.

FRODAIR IRON & STEEL CO., LTD., FENCHURCH HOUSE, LONDON, E.C.3.

Raw Material Markets.

Generally speaking, business in the iron and steel markets continues to be restricted by holiday influences. An increasing proportion of the business available, however, is being placed in Britain and prospects for the autumn trading are very promising. British export business is being jeopardised to some extent by the fall in the value of the dollar. A general uncertainty is to be witnessed in overseas markets at the moment, largely owing to the fluctuating exchanges and the currency and other restrictions which were to have been dissolved by the London Conference.

Pig-Iron.

MIDDLESBROUGH.—Apart from a temporary lull in activities on the pig-iron market, due to seasonal influences, there are signs of a reawakening of interest. Deliveries of iron are being resumed to Scottish East-Coast ports. A fair amount of export business is being secured, but at severely-cut prices. At the Cargo Fleet works, where two months ago an additional blast furnace was blown in, a furnace has just been stopped for repairs, thus bringing the number in blast on the North-East Coast down again to 18. Supplies of iron from the furnaces in question, however, are used in the associated steelworks, so that the open market position is unaffected. Prices of Cleveland iron are all maintained. No. 3 G.M.B. is quoted at 62s. 6d. per ton delivered Middlesbrough, 64s. 6d. delivered North-East Coast, 65s. 3d. delivered Glasgow and 62s. 3d. delivered Falkirk. To the above prices 2s. 6d. is added where No. 1 foundry iron is required and 1s. per ton less than the No. 3 figure is quoted for either No. 4 foundry or No. 4 forge iron.

There has been a heavy inquiry for East Coast hematite, owing to the possibility of an increase in prices, and a number of large contracts have been put through at the current levels, which are 59s. for mixed numbers and 59s. 6d. for No. 1 quality. Export business has also improved, and several makers are well sold for the next two or three months. However, there are still large stocks of iron yet to be liquidated.

LANCASHIRE.—There has been an improvement in the demand for pig-iron in Lancashire, and several Derbyshire and Staffordshire producers report increased sales to this district for forward delivery, but little of this can be ascribed to any improvement in conditions in the consuming industries. The competition from scrap pig-iron continues unabated. As regards pig-iron prices, for delivery to users in the Manchester price zone, Derbyshire, Staffordshire and Cleveland brands are all on offer on the basis of 67s. per ton, with Northants at 65s. 6d., Derbyshire forge iron at 62s., Scottish foundry at around 80s., East Coast hematite at 74s. 6d., and West Coast at 80s. 6d.

MIDLANDS.—Light-castings manufacturers in this area continue to be well employed, and, in addition, increased activity is reported at one or two of the general engineering firms. There was a meeting of the Central Pig-iron Producers' Association last week when it was decided to make no change in quotations, which are 62s. 6d. for Northants No. 3 and 66s. for Derbyshire, Lincolnshire and Staffordshire No. 3, with 5s. less for forge iron for bar-iron making. Any forge iron consumed in the foundries is at 4s. per ton below No. 3. These figures include delivery to Birmingham and Black Country stations. There is a small rebate for large consumers. Cleveland No. 3 foundry continues to be consumed in South Staffordshire, the price being 66s. per ton delivered. Scottish No. 3 is quoted at about 85s., medium-phosphorus iron from 70s. to 75s. and special low-phosphorus grades from 80s. to 90s., while refined pigs vary according to quality and source of supply, the figures ranging from £5 to £6 15s. per ton delivered this district. The demand for special foundry irons is gradually expanding in this area.

SCOTLAND.—Business has been gradually resumed in the Glasgow area this week, after the holiday interruption. Scottish pig-iron quotations are unchanged at 65s. per ton for No. 3 foundry, f.o.t. furnaces, and 67s. 6d. for No. 1 grade. No. 3 Cleveland iron remains at 65s. 3d. f.o.t. Glasgow and 62s. 3d. f.o.t. Falkirk. Other English irons are offered at 2s. 3d. per ton less. More Cleveland iron is now coming forward, but new long-term contracts are still scarce.

Coke.

There has been no alteration in the prices of foundry coke, in spite of the recent suggestion of increased levels. Buyers generally continue to display little or no interest in forward contracts. Quotations are as follow:—Best Durham foundry coke, 36s. to 38s.; second grades, 34s. to 35s.; Scottish low-ash coke, 39s. to 40s.; Welsh coke, 28s. to 45s., all per ton delivered in the Birmingham district.

Steel.

Although the market is affected by the holiday conditions, the volume of business on the whole is satisfactory. The home demand continues to be the mainstay of the British steel trade, export business being irregular. A considerable inquiry is being received from overseas, but only a small proportion materialises into business, principally owing to the restrictions upon the movement of money in many foreign countries, states the official report of the London Iron and Steel Exchange. The semi-finished steel department has been somewhat disturbed by reports of large sales of Continental billets to home producers at cheap prices. The British works, however, are well placed as regards orders, and until the last week or two took practically all the business offered in the market. Business in finished steel has been irregular owing to the holidays. In this department also there have been some sales of Continental material, but generally speaking the British works have been able to meet the competition in finished steel. The demand on home account has been fairly active, but export business in finished steel generally is slow. The sheet and tinplate makers, however, are better off in this respect.

Scrap.

Generally speaking, there is a steady demand for cast-iron scrap. In the Cleveland district there is a noticeably improved demand for light metal and up to 37s. per ton is said to have been paid recently. Conditions remain steady in the Midlands market. In Scotland many of the foundries have now resumed work, and scrap metal is again on the move. Prices are generally firm at 50s. for machinery cast iron, in pieces suitable for cupola use, and 46s. 6d. for ordinary cast iron to the same specification. The South Wales market continues to experience a fair demand, there being a stronger call for light cast scrap, at about 38s. to 39s. per ton.

Metals.

Copper.—The copper market has experienced a setback following the collapse of the upward movement on Wall Street, and heavy selling by speculators of standard metal has been experienced on the London Metal Exchange. The position at the moment appears to be somewhat steadier. There has been an absence of trade demand during the past few weeks, owing to seasonal influences, but consumers are now showing more interest. The demand for electrolytic copper, and for wire bars especially, has certainly been very poor. Rhodesian fire-refined metal has, however, been in better call. Judging from recent reports, the producers seem to be adopting a policy of increasing, rather than decreasing, their mine outputs, although it is true that the latter were at a very low level. In view of the large stocks of copper still in existence, however, the news has not been favourably received by the market.

The week's prices have been as follow :—

Cash.—Thursday, £36 13s. 9d. to £36 15s.; Friday, £37 1s. 3d. to £37 2s. 6d.; Monday, £36 11s. 3d. to £36 12s. 6d.; Tuesday, £35 18s. 9d. to £36; Wednesday, £36 8s. 9d. to £36 10s.

Three Months. — Thursday, £36 17s. 6d. to £36 18s. 9d.; Friday, £37 3s. 9d. to £37 5s.; Monday, £36 15s. to £36 16s. 3d.; Tuesday, £36 1s. 3d. to £36 2s. 6d.; Wednesday, £36 12s. 6d. to £36 13s. 9d.

Tin.—Tin prices have remained steady at the lower levels reached recently. The market appears to be holding back until it is possible to get a clearer view of the international financial situation, particularly as regards the United States. The consumption of tin in the latter country is stated to be reviving in certain trades. The American output of tinplates during June, for example, was the highest for any month with the exception of May, 1929. British consumers have not been buying, however, and their hesitancy has contributed to a large extent to the heaviness of the market. World stocks of tin are estimated to have shown a further heavy fall during July.

Daily quotations :—

Cash.—Thursday, £214 15s. to £214 17s. 6d.; Friday, £216 to £216 5s.; Monday, £214 12s. 6d. to £214 17s. 6d.; Tuesday, £212 7s. 6d. to £212 12s. 6d.; Wednesday, £214 5s. to £214 7s. 6d.

Three Months.—Thursday, £214 17s. 6d. to £215; Friday, £216 5s. to £216 10s.; Monday, £215 7s. 6d. to £215 10s.; Tuesday, £213 to £213 5s.; Wednesday, £214 12s. 6d. to £214 15s.

Spelter.—Quotations in this market remain fairly steady. Messrs. Brandeis, Goldschmidt report that, in comparison with the other metals, spelter has displayed better powers of resistance to selling pressure. Although the price has fallen slightly, the tone of the market is quite good. Consumers, both in England and on the Continent, are moderately well occupied, and there is a slight improvement in the demand from galvanisers.

Price fluctuations :—

Ordinary.—Thursday, £17 6s. 3d.; Friday, £17 7s. 6d.; Monday, £17 2s. 6d.; Tuesday, £16 11s. 3d.; Wednesday, £16 13s. 9d.

Lead.—Demand for lead has been quiet, although consumption continues on a satisfactory scale, report Messrs. Henry Gardner. Manufacturers supplying the building trades have been quite active, but the influence of the holiday season is now making itself felt.

Daily market prices :—

Soft Foreign (Prompt).—Thursday, £13 2s. 6d.; Friday, £13 6s. 3d.; Monday, £12 18s. 9d.; Tuesday, £12 5s.; Wednesday, £12 8s. 9d.

Scrap Movements.

Advances in steel production have caused a large increase in German imports of scrap and also have sharply reduced German exports. Whereas in the first quarter of 1932 only 12,675 metric tons of scrap were imported into Germany, 1933 imports over a like period have amounted to 136,550 tons, a total 50 per cent. greater than for the whole of 1932. The drop in exports from 75,352 tons in January-March period of 1932 to 26,191 tons in 1933 leaves the import trade well in excess (110,000 tons) of the export, whereas prior to this time Germany has had a distinctly favourable balance in scrap. This trend becomes the more significant as an extensive programme has been adopted for scrapping enough old and obsolete German shipping to provide about 240,000 tons of scrap. The principal sources from which this scrap has come are Holland (67,553 tons), Belgium (43,683 tons) and Great Britain (12,044 tons). The rapid rise of the Belgian trade—from 1,392 tons in the first quarter of 1932 to the 43,683 tons noted above—is reported to have occasioned considerable dissatisfaction on the part of the Belgian steelworks and to have led to some attempt to prohibit the exportation of this material, which the Government refused to do. Thereupon the Belgian works organised a joint scrap-purchasing comptoir to check this trade, to institute a scale of prices for different supply districts and to take other appropriate measures.

Patents and Trade Marks.—King's Patent Agency Limited, Wardrobe Chambers, 146a, Queen Victoria Street, London, E.C.4, has published a booklet, "Patents and Trade Marks," including some useful information on designs and copyright, patents for inventions, employees' inventions, procedure in patenting, patents abroad, sales of patents, and trade marks. This booklet may be obtained post free on application to Messrs. King's Agency.

Corrosion Research.—In "Gas und Wasserfach," F. Eisenstecken describes the results of recent research on the corrosion of steel pipes when exposed to highly active materials, with special reference to the effects produced on buried pipes. In discussing the various precautions which may be taken to minimise corrosion, the author describes the results obtained at Hamburg in corrosion prevention by means of stray currents.

universally recognised as the leading brand of Cylinder Pig Iron

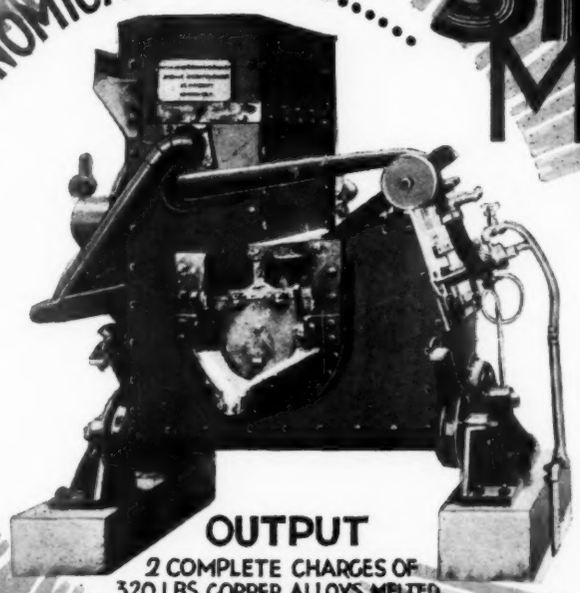
WARNER CBR

The way to BETTER castings

WARNER & CO. LTD. CARGO FLEET MIDDLESBROUGH

FOR FAST & ECONOMICAL MELTING.....

SKLENAR Midget FURNACE



OUTPUT
2 COMPLETE CHARGES OF 320 LBS. COPPER ALLOYS MELTED IN ONE HOUR AFTER PREHEAT

COPYRIGHT DESIGN INDUSTRIAL PROPERTIES LTD.

OIL-FIRED

CHARACTERISTIC FEATURES:

No crucibles or pit fires required; Compact with rapidity of service; Perfect control of atmospheric conditions in the furnace with temperatures ranging from 500°C. to 1600°C.; Low fuel consumption; Better metal and reduced metallic losses; Metal under observation throughout; Reduced cost of upkeep; Cost of production reduced 60%; Perfect control of alloys; Oil burning equipment capable of running for long periods without fear of breakdown.

OIL CONSUMPTION: 4½ gallons per hour of fuel oil.
OTHER STANDARD SIZES FOR NON-FERROUS METALS: Coke or Oil fired up to 2 tons. Larger sizes on application.
OIL FIRED FURNACES FOR MELTING GREY IRON AND SEMI-STEEL: Sizes and prices on application.

WILL SAVE UP TO £900 PER ANNUM.

SEND US YOUR ENQUIRIES — OUR TECHNICAL STAFF IS AT YOUR SERVICE.

Telegrams: SKLENAR, Westcent, London.

BRITISH REVERBERATORY FURNACES LTD.
88. KINGSWAY · LONDON. W.C.2.

RAW MATERIALS—PRICE LIST.

(Wednesday, August 2, 1933.)

COPPER.

	£	s.	d.
Standard cash	36	8	9
Three months	36	12	6
Electrolytic	41	0	0
Tough	39	0	0
Best selected	39	15	0
Sheets	68	0	0
India	50	0	0
Wire bars	41	15	0
Ingot bars	41	15	0
H.C. wire rods	44	0	0
Off. av. cash, July	37	19	0 13/16
Do., 3 mths., July	38	2	3 1/2
Do., Sttlmnt., July	37	19	4 9/16
Do., Electro, July	41	19	6 1/2
Do., B.S., July	40	19	4 1/2
Do., wire bars, July	42	8	6 9/16
Solid drawn tubes			10 1/2d.
Brazed tubes			10 1/2d.
Wire			7d.

BRASS.

Solid drawn tubes	9 1/2d.
Brazed tubes	11 1/2d.
Rods, drawn	8 1/2d.
Rods, extd. or rlld.	5d.
Sheets to 10 w.g.	8d.
Wire	8d.
Rolled metal	7 1/2d.
Yellow metal rods	4 1/2d.
Do. 4 × 4 Squares	5 1/2d.
Do. 4 × 3 Sheets	5 1/2d.

TIN.

	£	s.	d.
Standard cash	214	5	0
Three months	214	12	6
English	215	0	0
Bars	216	0	0
Straits	219	7	6
Australian (nom.)			—
Eastern	222	0	0
Banca	219	7	6
Off. av. cash, July	216	15	7 9/16
Do., 3 mths., July	216	12	4 1/2
Do., Sttlmt., July	216	15	2 9/16

SPELTER.

	£	s.	d.
Ordinary	16	13	9
Remelted	17	0	0
Hard	15	0	0
Electro 99.9	19	2	6
English	17	7	6
India	16	17	6
Zinc dust	20	0	0
Zinc ashes	4	5	0
Off. aver., July	17	15	10
Aver. spot, July	17	15	10 1/16

LEAD.

	£	s.	d.
Soft foreign ppt.	12	8	9
Empire	12	10	0
English	14	0	0
Off. average, July	13	10	2 9/16
Average spot, July	13	8	2 1/16

ALUMINIUM.

Ingots	£100 to £105
Wire	1/1 to 1/9 lb.
Sheet and foil	1/2 to 2/9 lb.

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	25	15	0
Do., V.M. ex-whse.	25	5	0
Rods	30	10	0

ANTIMONY.

	£	s.	d.		£	s.	d.
English	37	10	0	to 40	0	0	
Chinese				26	15	0	
Crude					—		

QUICKSILVER.

	£	s.	d.		£	s.	d.
Quicksilver	8	7	6	to 9	0	0	

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	6 10 0
45/50%	12 10 0
75%	18 2 6
Ferro-vanadium—	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% carbon-free of Mo.	5/6 per lb.
Ferro-titanium—	
23/25% carbon-free	9d. lb.
Ferro-phosphorus, 20/25%	£15 0 0
Ferro-tungsten—	
80/85%	1/9 lb.
Tungsten metal powder—	
98/99%	2/– lb.
Ferro-chrome—	
2/4% car.	25 10 0
4/6% car.	21 17 6
6/8% car.	19 7 6
8/10% car.	18 17 6
Ferro-chrome—	
Max. 2% car.	30 0 0
Max. 1% car.	31 0 0
Max. 0.70% car.	42 10 0
70% carbon-free	10 1/2d. lb.
Nickel—99.5/100%	£225 to £230
"F" nickel shot	£202 10 0
Ferro-cobalt	5/6 lb.
Metallic chromium—	
96/98%	2/8 lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export	(nom.) £9 15 0
Metallic manganese—	
94/96% carbon-free	1/2 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 5/16 in.	1/– lb.
Flats, ½ in. × ¼ in. to under 1 in. × 5/8 in.	3d. lb.
Do., under ½ in. × ¼ in.	1/– lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

	£	s.	d.		£	s.	d.
South Wales—							
Heavy steel					2	5	0
Bundled steel and shrngs.	1	17	6	to 2	4	0	
Mixed iron and steel					2	1	6
Heavy cast iron	2	3	6	to 2	4	6	
Good machinery	2	8	0	to 2	10	0	
Cleveland—							
Heavy steel	2	2	6	to 2	5	0	
Steel turnings					1	11	6
Cast-iron borings					1	2	0
Heavy forge					2	10	0
W.I. piling scrap					2	0	0
Cast-iron scrap	1	19	0	to 2	1	0	
Midlands—							
Light cast-iron scrap	1	17	6	to 2	0	0	
Heavy wrought iron					2	5	0
Steel turnings, f.o.r.					1	5	6
Scotland—							
Heavy steel	1	18	9	to 2	0	0	
Ordinary cast iron					2	6	6
Engineers' turnings					1	11	0
Cast-iron borings					1	12	6
Wrought-iron piling					2	1	0
Heavy machinery					2	10	0

London—Merchants' buying prices, delivered yard.

	£	s.	d.
Copper (clean)	31	0	0
Brass	20	0	0
Lead (less usual draft)	11	10	0
Tea lead	10	0	0
Zinc	11	10	0
New aluminium cuttings	74	0	0
Brazlery copper	28	0	0
Gunmetal	26	0	0
Hollow pewter	135	0	0
Shaped black pewter	100	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	65/–
Foundry No. 3	62/6
,, at Falkirk	62/3
,, at Glasgow	65/3
Foundry No. 4	61/6
Forge No. 4	61/6
Hematite No. 1, f.o.t.	59/6
Hematite M/Nos., f.o.t.	59/–
N.W. Coast—	
Hem. M/Nos. d/d Glas.	68/6
,, d/d Birm.	84/6
Malleable iron d/d Birm.	115/–
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	62/–
,, No. 3 fdry.	66/–
Northants forge	58/6
,, fdry. No. 3	62/6
,, fdry. No. 1	65/6
Derbyshire forge	62/–
,, fdry. No. 3	66/–
,, fdry. No. 1	69/–
Scotland—	
Foundry No. 1	67/6
,, No. 3	65/–
Hem. M/Nos. d/d	66/–
Sheffield (d/d district)—	
Derby forge	59/6
,, fdry. No. 3	63/6
Lincs forge	59/6
,, fdry. No. 3	63/6
E.C. hematite	75/6
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3	67/–
Staffs fdry. No. 3	67/–
Northants fdry. No. 3	65/6
Cleveland fdry. No. 3	67/–
Dalzell, No. 3 (special)	102/6 to 105/–
Glengarnock, No. 3	80/–
Clyde, No. 3	80/–
Monkland, No. 3	80/–
Summerlee, No. 3	80/–
Eglinton, No. 3	80/–
Gartsherrie, No. 3	80/–
Shotts, No. 3	80/–

FINISHED IRON AND STEEL.

Usual district deliveries for iron; delivered consumer's station for steel.

Iron—	£	s.	d.		£	s.	d.
Bars (cr.)	9	0	0	to 9	15	0	
Nut and bolt iron	6	15	0	to 7	10	0	
Hoops	10	10	0	to 12	0	0	
Marked bars (Staffs) f.o.t.				12	0	0	
Gas strip	10	10	0	to 12	0	0	
Bolts and nuts, ¾ in. × 4 in.				13	0	0	
Steel—							
Plates, ship, etc.	8	15	0	to 8	17	6	
Boiler plts.				8	5	0	
Chequer plts.				10	7	6	
Angles				8	7	6	
Tees				9	7	6	
Joists				8	15	0	
Rounds and squares, 3 in. to 5½ in.				9	7	6	
Rounds under 3 in. to ½ in. (Untested)	6	17	6	& up.			
Flats—8 in. wide and over				8	12	6	
,, under 8 in. and over 5 in.				8	17	6	
Rails, heavy	8	5	0	to 8	10	0	
Fishplates				12	0	0	
Hoops (Staffs)	9	10	0	& up.			
Black sheets, 24g. (4-t. lots)				10	0	0	
Galv. cor. shts. ,,				12	10	0	
Galv. flat shts. ,,				13	0	0	
Galv. fencing wire, 8g. plain				14	0	0	
Billets, soft	5	0	0	to 5	12	6	
Billets, hard	6	12	6	to 7	2	6	
Sheet bars	4	15	0	to 5	5	0	
Tin bars				4	15	0	

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	11d.
Sheet to 10 w.g.	12d.
Wire	12½d.
Rods	11d.
Tubes	15½d.
Castings	13d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/0½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	17.34
No. 2 foundry, Valley	16.50
No. 2 foundry, Birm.	13.00
Basic	17.89
Bessemer	18.89
Malleable	18.39
Grey forge	18.39
Ferro-mang. 80%, seaboard	82.00
O.-h. rails, h'y, at mill	40.00
Billets	26.00
Sheet bars	26.00
Wire rods	35.00
	Cents.
Iron bars, Phila.	1.86
Steel bars	1.60
Tank plates	1.60
Beams, etc.	1.60
Skelp, grooved steel	1.60
Steel hoops	1.60
Sheets, black, No. 24	2.25
Sheets, galv., No. 24	2.85
Wire nails	2.10
Plain wire	2.10
Barbed wire, galv.	2.60
Tinplates, 100-lb. box	$4.25

COKE (at ovens).

Welsh foundry	20/– to 22/6
,, furnace	15/– to 15/6
Durham and Northumberland—	
,, foundry	21/– to 25/–
,, furnace	13/3
Midlands, foundry	—
,, furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes 20×14 per box	17/–
,, 28×20 ,,	34/–
,, 20×10 ,,	24/6
,, 18¾×14 ,,	17/9
C.W. 20×14 ,,	16/–
,, 28×20 ,,	32/6
,, 20×10 ,,	22/9
,, 18¾×14 ,,	16/6

SWEDISH CHARCOAL IRON & STEEL.

	£	s.	d.		£	s.	d.
Pig-iron	£6	0	0	to £7	0	0	
Bars-hammered, basis	£16	0	0	to £16	10	0	
Bars and nail-rods, rolled, basis	£15	15	0	to £16	0	0	
Blooms	£10	0	0	to £12	0	0	
Keg steel	£30	0	0	to £31	0	0	
Faggot steel	£18	0	0	to £23	0	0	
Bars and rods dead soft, st'l	£10	0	0	to £12	0	0	

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.	
July	27 ..	36	13	9	dec. 7/6
,,	28 ..	37	1	3	inc. 7/6
,,	31 ..	36	11	3	dec. 10/-
Aug.	1 ..	35	18	9	,, 12/6
,,	2 ..	36	8	9	inc. 10/-

Electrolytic Copper.

		£	s.	d.	
July	27 ..	41	0	0	No change
,,	28 ..	41	0	0	,, ,,
,,	31 ..	41	0	0	,, ,,
Aug.	1 ..	41	0	0	,, ,,
,,	2 ..	41	0	0	,, ,,

Standard Tin (cash).

		£	s.	d.	
July	27 ..	214	15	0	No change
,,	28 ..	216	0	0	inc. 25/-
,,	31 ..	214	12	6	dec. 27/6
Aug.	1 ..	212	7	6	,, 45/-
,,	2 ..	214	5	0	inc. 37/6

Tin (English ingots).

		£	s.	d.	
July	27 ..	215	5	0	dec. 5/-
,,	28 ..	216	10	0	inc. 25/-
,,	31 ..	215	5	0	dec. 25/-
Aug.	1 ..	213	0	0	,, 45/-
,,	2 ..	215	0	0	inc. 40/-

Spelter (ordinary).

		£	s.	d.	
July	27 ..	17	6	3	dec. 1/3
,,	28 ..	17	7	6	inc. 1/3
,,	31 ..	17	2	6	dec. 5/-
Aug.	1 ..	16	11	3	,, 11/3
,,	2 ..	16	13	9	inc. 2/6

Spelter (Electro, 99.9 per cent.).

		£	s.	d.	
July	27 ..	19	12	6	dec. 2/6
,,	28 ..	19	15	0	inc. 2/6
,,	31 ..	19	10	0	dec. 5/-
Aug.	1 ..	19	2	6	,, 7/6
,,	2 ..	19	2	6	No change

Zinc Sheets (English).

		£	s.	d.	
July	27 ..	26	0	0	No change
,,	28 ..	26	0	0	,, ,,
,,	31 ..	26	0	0	,, ,,
Aug.	1 ..	25	15	0	dec. 5/-
,,	2 ..	25	15	0	No change

Lead (English).

		£	s.	d.	
July	27 ..	14	10	0	dec. 5/-
,,	28 ..	14	15	0	inc. 5/-
,,	31 ..	14	10	0	dec. 5/-
Aug.	1 ..	14	0	0	,, 10/-
,,	2 ..	14	0	0	No change

AVERAGE MONTHLY PRICES OF FURNACE COKE D/D MIDDLESBROUGH.

Year	January	February	March	April	May	June	July	August	September	October	November	December	Yearly average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1901	0 17 6	0 14 0	0 13 0	0 14 0	0 14 6	0 15 0	0 15 3	0 15 3	0 15 9	0 16 6	0 16 9	0 16 9	0 16 4½
1902	0 16 9	0 15 0	0 15 6	0 15 0	0 15 0	0 15 3	0 15 3	0 15 3	0 15 6	0 16 0	0 16 6	0 16 0	0 15 5
1903	0 15 9	0 16 0	0 16 3	0 16 9	0 16 6	0 16 3	0 16 0	0 15 9	0 15 6	0 15 0	0 14 6	0 14 0	0 15 8½
1904	0 13 9	0 13 9	0 13 3	0 14 3	0 14 6	0 14 3	0 14 3	0 14 3	0 14 3	0 14 0	0 14 0	0 14 6	0 14 1½
1905	0 14 9	0 15 3	0 15 3	0 15 3	0 15 6	0 15 6	0 15 6	0 15 6	0 15 6	0 15 6	0 15 9	0 17 0	0 15 5½
1906	0 17 6	0 17 6	0 17 0	0 17 0	0 17 0	0 16 6	0 17 0	0 17 0	0 18 3	0 18 6	0 19 0	1 0 0	0 17 8½
1907	1 4 6	1 5 0	1 5 0	1 0 6	1 2 0	1 1 0	1 1 0	1 1 0	1 2 0	1 1 6	1 0 0	0 17 0	1 1 8½
1908	0 16 0	0 16 0	0 15 6	0 16 0	0 16 3	0 16 0	0 15 6	0 15 6	0 15 6	0 15 3	0 16 0	0 16 0	0 15 9½
1909	0 16 0	0 15 3	0 15 0	0 14 9	0 15 6	0 15 9	0 15 6	0 15 6	0 16 6	0 17 0	0 17 6	0 17 0	0 15 11½
1910	0 18 4½	0 18 6½	0 18 0	0 18 0	0 17 10½	0 17 0	0 16 1½	0 15 9½	0 15 11	0 16 0	0 15 9½	0 15 8	0 16 11
1911	0 16 0	0 15 10½	0 15 6	0 15 3	0 14 9	0 14 6	0 14 6	0 14 6	0 14 6	0 14 11½	0 15 0½	0 16 3½	0 15 1½
1912	0 17 3	0 17 3	0 18 6	0 18 10	0 19 0	0 19 4½	0 19 10½	1 0 9½	1 2 9	1 4 1½	1 5 8½	1 8 6	1 1 0
1913	1 5 9	1 4 11	1 5 0	1 5 0	1 4 9½	1 0 4½	0 19 5½	0 18 3	0 18 0	0 18 2½	0 18 6	0 18 6	1 1 4½
1914	0 18 2	0 17 1	0 17 0	0 17 0	0 17 4	0 17 6	0 17 6	0 18 5	0 18 4	0 17 9	0 17 6	0 18 5	0 17 8
1915	0 17 10½	0 17 9	1 0 4½	1 7 7½	1 9 4½	1 10 7½	1 9 7	1 7 3	1 5 4	1 4 9	1 9 6	1 13 0	1 6 1
1916	1 10 9	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6½
1917	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 14 3	1 15 6	1 11 2½
1918	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6
1919	1 15 6	1 15 6	1 15 6	1 15 6	2 1 6	2 1 6	2 3 9	2 10 6	2 10 6	2 10 6	2 10 6	2 10 6	2 3 5
1920	2 12 3	2 14 0	2 19 0	2 19 0	3 3 8	3 6 0	3 6 0	3 6 0	3 6 0	3 6 0	3 6 0	3 6 0	3 2 6
1921	3 1 0½	2 19 0	2 16 0	2 7 0	2 6 6	2 6 6	2 0 6	2 0 0	1 13 11	1 12 9	1 10 4½	1 8 3	2 3 6½
1922	1 7 0½	1 8 1½	1 9 7½	1 8 4½	1 7 11½	1 7 3	1 6 9½	1 6 10½	1 7 0½	1 10 2½	1 10 0	1 9 11½	1 8 3½
1923	1 11 3	1 14 6	2 0 1½	2 2 8½	2 4 4½	2 2 10½	2 1 0½	2 1 6	2 0 9½	1 18 9	1 18 8½	1 18 3	1 19 7½
1924	1 16 6½	1 14 9	1 11 11½	1 10 0½	1 8 1½	1 7 8½	1 7 3	1 6 3	1 6 0	1 5 0	1 5 0	1 5 0	1 9 5½
1925	1 4 10½	1 4 1½	1 13 3	1 2 4½	1 2 2½	1 1 5½	1 1 3½	1 4 9	0 18 10½	0 18 4½	0 19 6½	1 1 4½	1 2 8½
1926	1 2 1½	1 0 9	0 19 2½	0 18 6½	*	*	*	*	*	*	*	1 5 0	1 1 1½
1927	1 5 6	1 4 9½	1 6 1½	1 3 9	1 2 6	1 0 8½	0 19 4½	0 19 0	0 18 7½	0 18 0	0 17 10½	0 17 6	1 1 1½
1928	0 17 6	0 17 10½	0 18 0½	0 17 11½	0 17 8½	0 17 6½	0 17 7½	0 17 6½	0 17 6	0 17 7½	0 17 7½	0 17 6	0 17 8
1929	0 17 7½	0 18 0	0 19 0	0 19 6½	0 18 10½	0 19 10½	1 1 3½	1 1 8½	1 3 0	1 3 6	1 3 8	1 3 1½	1 0 9½
1930	1 2 6½	1 1 3	1 0 3	0 19 1½	0 17 7	0 16 10½	0 16 6	0 16 6	0 16 9	0 17 0	0 17 0	0 17 0	0 18 2½
1931	0 17 0	0 16 7½	0 16 0	0 16 0	0 15 11	0 15 5	0 15 1	0 15 0	0 15 0	0 16 9	0 17 0	0 16 6	0 16 0½
1932	0 17 0	0 16 11½	0 16 5½	0 15 9	0 15 7½	0 15 6	0 15 6	0 14 9½	0 14 6½	0 14 6	0 14 6	0 15 4	0 15 6½
1933	0 16 0½	0 15 9½	0 15 6½	0 15 3	0 15 3	0 15 6	0 15 6	—	—	—	—	—	—

* Strike period. || Five months.

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.

13, RUMFORD STREET, LIVERPOOL.

PIG IRON

REGISTERED TRADE MARK

All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,

CENTRAL CHAMBERS, 93, HOPE ST., GLASGOW, C.2.

ZETLAND ROAD, MIDDLESBROUGH.

SITUATIONS VACANT AND WANTED.

COMPETENT Patternmoulder wanted immediately, Derby area. State age, experience, and wages required.—Box 476, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY Foreman wanted for a foundry in the Manchester district employed on general work, large and small, including plate and machine moulding. Describe experience fully and state salary required.—Box 474, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

GOOD Moulder, ferrous and non-ferrous. Small foundry, South London. To take charge later if competent.—Write, Box 472, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

EMPLOYMENT REGISTER.

Conducted by the Institute of British Foundrymen by courtesy of the proprietors of THE FOUNDRY TRADE JOURNAL.

Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, from whom full particulars can be obtained of this service.

FOUNDRY and Patternshop Foreman requires position. Holds similar position at present with high-class firm. Up-to-date cupola practice, sand preparation, experienced light and heavy floor work, machine moulding. Accustomed to estimating. (222)

BUSINESS FOR SALE.

FOR Sale as a Going Concern, the Business and Works of Derby Castings, Limited, Ironfounders, successors to Andrew Handyside & Company, Limited, comprising Freehold and Leasehold Property of 2½ Acres, Premises, Plant, Goodwill, etc.—Full particulars on application to the Receiver, JAMES DOUGLAS, 31, Budge Row, Cannon Street, London, E.C.4.

PATENT.

THE Proprietor of the Patent No. 334929, for "Improvements in or relating to the Manufacture of Rolls," is desirous of entering into arrangements by way of licence and otherwise on reasonable terms for the purpose of exploiting the same and ensuring its full development and practical working in this country. —All communications should be addressed in the first instance to Haseltine, Lake & Company, 28, Southampton Buildings, Chancery Lane, London, W.C.2.

MACHINERY.

FOUNDRY Transverse Bar-Testing Machine by Avery, for 2-in. x 1-in. Bars, 1 to 3 ft. long, calibrated up to 40 cwts., with deflection scale; in good working order. Price £30 or nearest offer.—HARTLEY, SONS & COMPANY, Engineers, Etruria.

MACHINERY—*Continued.*

PNEUMATIC MOULDING MACHINES

No. 9 "Ajax" Jolt Turnover.
"Wallwork" Squeezer, 17½-in. x 12½-in. boxes.
"Tabor" Portable Jolt Rollover.
Four No. 1 Britannia Jolters.

HAND MOULDING MACHINES

Eight Standard-size Adaptables with Tail Guides.
Two Large-size Ditto, with Star handle, turnover and adaptable draw frame.
"Coventry" Headpress Squeezer Table, 22 in. x 30 in.
Four 36-in. Farwell Type Universal Squeezers.
Also
Pneulec Sand-drying Plant, 1 ton per hour, Sand Mills, Disintegrators, etc.

S. C. BILSBY, A.M.I.C.E., A.M.I.E.E.
CROSSWELLS ROAD (Adjoining Railway Crossing), LANGLEY, Nr. Birmingham.
'Phone: Broadwell 1359.

THOS. W. WARD, LTD.
Pneumatic SAND MOULDING MACHINE, admits boxes 16" x 16" x 6".
Four Cutter PLANER and MOULDER, cap. 10" x 4¾".
HACK SAWING MACHINES, caps. from 3" to 12" square.
4 LANCS BOILERS, 30' x 8', 200 lbs. w.p.
VERT. COCHRAN BOILER, 16' 3" x 7' 6", 100 lbs. w.p.
Write for "Albion" Catalogue.
'Grams: "Forward." 'Phone: 23001 (10 lines).
ALBION WORKS, SHEFFIELD.

MISCELLANEOUS.

FOUNDRY PLUMBAGO.—We recommend our "STANDARD No. 1"—high grade—low price. 18s. *cwt. carr. paid*, which always gives satisfaction.—WILLIAM OLSEN, LIMITED, Cogan Street, Hull.

To Engineers, Founders, Manufacturers. Fine site of nearly 3 acres on Arterial Road with Foundry and Workshops and own Rail Sidings into premises. Modern Offices, Warehouse and Workrooms. Central Heating.
CHARLES A. TRICKS & SON, Auctioneers,
ST. NICHOLAS STREET, BRISTOL.

MISCELLANEOUS—*Continued.*

BRITAIN'S BEST CRUCIBLE stocked and distributed by WILLIAM OLSEN, LIMITED, Hull. Write for terms. Also General Foundry Supplies. "The right articles at the right prices."

WANTED, large quantities of Clean "Y" Alloy and Duralumin Turnings of standard quality.—Full particulars with samples to Box 470, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

'Phone: 287 SLOUGH

HAND MOULDING MACHINES

Six Standard "Adaptables" £12 each
24" × 30" Darling & Sellars turnover £15
Two 18" × 16" Coventry HEADRAM squeezers ... ... £18 each

PNEUMATIC MACHINES

24" × 18" Tabor rollover, portable £55
30" × 20" Macdonald jolt rollover... £60
20" × 16" Macdonald jolt rollover... £40
Britannia No. 0, 1 and 2 jolters ...
No. 20 Macdonald plain jolter with 90" × 90" table, jolts 8 tons £160

AIR COMPRESSORS
ALL SIZES IN STOCK.

Every Machine overhauled and retested.

BUY FROM ME AND SAVE MONEY!

ALEX. HAMMOND, *Foundry Machinery Merchant,*
14, AUSTRALIA ROAD, SLOUGH

COLBOND No. 1

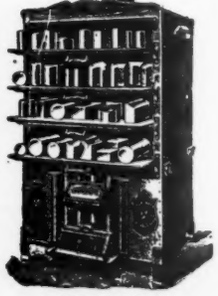
Can YOU Afford NOT to Use It

at £7 10s. per ton?

A cwt. sample at 11/6 will prove its value in your foundry.

Colbond Bonds Your Sand as YOU want it.

Particulars from:
COLBOND,
24, Martin Lane, Cannon St., London, E.C.4.
Telephone: Sloane 4862.



CORE OVEN.

THE "PORTWAY"

PORTABLE CORE OVENS

For Gas or Fuel.

TESTIMONIAL.
From The Braintree Castings Co.,
Chapel Hill Foundries, Braintree, Essex.

Gentlemen,
We are very pleased with the Core Oven we recently purchased from you. We find it dries the cores quickly without burning them. It is very handy and economical to use and is altogether superior to other ovens of this type we have in use. Will you please quote us your best price for four more like it.

Yours faithfully,
For The Braintree Castings Co.,
(Signed) W. B. LAKE, Director.

Makers—
C. PORTWAY & SON, Tortoise Stove & Portway Portable Oven Works, **HALSTEAD, ESSEX.**